The National Transuranic (TRU) Waste Disposal Program

The Next Step – Disposal of Remote-Handled TRU Waste at the Waste Isolation Pilot Plant

NMED

August 18, 2000

NMED KH PRESENTATION 8/18/00

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The Next Step-
Disposal of Remote-Handled TRU Waste

Tab 1	August 18, 2000 Meeting Agenda
Tab 2	Remote-Handled Presentation Handouts
Tab 3	National Academy of Sciences, National Research Council, *Improving Operations and Long-Term Safety of the Waste Isolation Pilot Plant*, Interim Report, 2000
Tab 4	WIPP Position Paper, *Maximum VOC Emission Rates from RH Canisters*, August 2000
Tab 5	DOE Order 435.1, *Radioactive Waste Management*, July 9, 1999 (Attachment: Implementation Manual)
Tab 6	62 FR 62079, *Joint NRC/EPA Guidance on Testing Requirements for Mixed Radioactive and Hazardous Waste*, November 20, 1997
Tab 7	EPA, *Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes: A Guidance Manual*, pp. 1-13 and 1-14, OSWER 9938.4-03, April 1994
Tab 8	EPA, *OSWER PBMS Implementation Plan, Rev. 1*, October 9, 1998
Tab 9	EPA, *The Relationship Between SW-846, PBMS and Innovative Analytical Technologies*, 1998
Tab 10	EEG, EEG-72 *A Comparison of the Risks From the Hazardous Waste and Radioactive Waste Portions of the WIPP Inventory*, July 1999

THE NEXT STEP-
DISPOSAL OF REMOTE-HANDLED TRU WASTE

Friday, August 18, 2000
New Mexico Environment Department

Agenda

9:00 AM - 9:15 AM	Greetings and Introductions
9:15 AM - 12:00 PM	Overview of RH TRU Program
12:00 PM - 1:00 PM	Lunch
1:00 PM - 2:45 PM	Questions and Answers

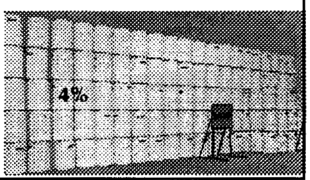
Notes:

The National Transuranic (TRU) Waste Disposal Program

The Next Step –
Disposal of Remote-Handled TRU Waste at the Waste Isolation Pilot Plant

Remote-Handled TRU Waste

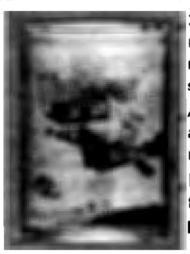
- Homogeneous solids, debris, soil/gravel
- Remote-handled may comprise ~4% of total WIPP waste volume (175,600 cubic meters)
  - 7,080 cubic meters



TRU Waste Classifications

Contact-handled

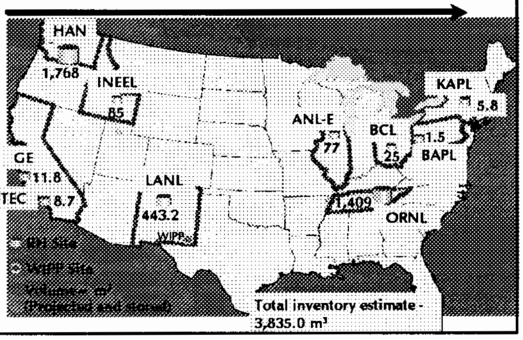
- Less than 200 millirem per hour dose rate at package surface
- Primarily Alpha-emitting



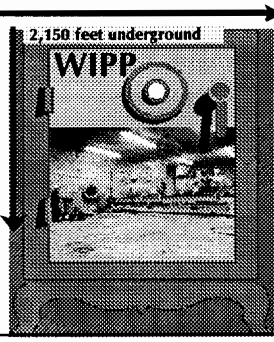
Remote-handled

- 200 millirems - 1,000 rems per hour dose rate at package surface
- Alpha, beta, gamma and neutron-emitting
- Larger amounts fission/activation products
  - Cesium - 137
  - Cobalt - 60
  - Strontium - 90

Where is the RH-TRU?



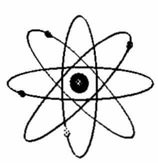
earthquakes...fires...
tornadoes...proximity
to humans...



Where RH-TRU Waste Should Be

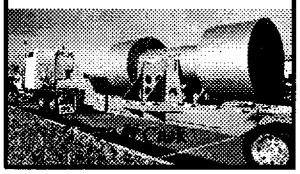
What is the RH-TRU Radioactive Inventory?

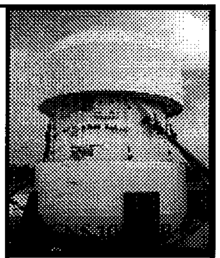
Radionuclide	Projected (2033) Radioactivity
Cs-137	8.98E+04 Ci
Ba-137m	8.49E+04 Ci
Sr-90	8.46E+04 Ci
Y-90	8.46E+04 Ci
Pu-241	2.28E+04 Ci
Pu-239	1.03E+04 Ci
Am-241	9.43E+03 Ci
Pu-240	5.05E+03 Ci
Pu-238	1.08E+03 Ci
Eu-152	1.76E+02 Ci
Total	3.93E+05 Ci *(limit:5.10E+06 Ci)*



RH – TRU Transportation

- Double confinement
- 3 drums, 325 Pu ^{239}FGE, 50 watts
- Total vehicle weight 80,000 lb
- Primary option for RH transportation





- Single confinement
- 10 drums, 20 Ci Pu, 100 watts
- Total vehicle weight 105,000 lb
- Another option for RH transportation

WIPP Plans Safe RH Disposal

Have

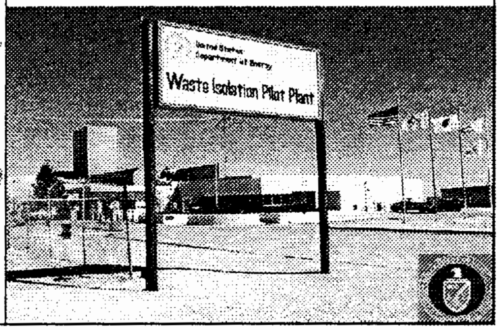
- Land Withdrawal Act authorizes CH and RH waste disposal
- Records of Decision for CH and RH
- NRC-certified shipping casks
- EPA Compliance Certification Final Rule

WIPP Plans Safe RH Disposal

Need

In sharing common responsibility to protect the public and environment, we must understand the requirements...

RH Characterization Regulatory Framework



SEPA

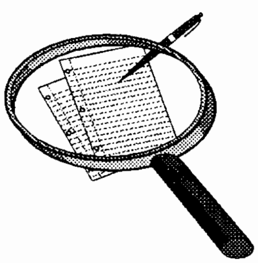
Quality Assurance for RH-TRU

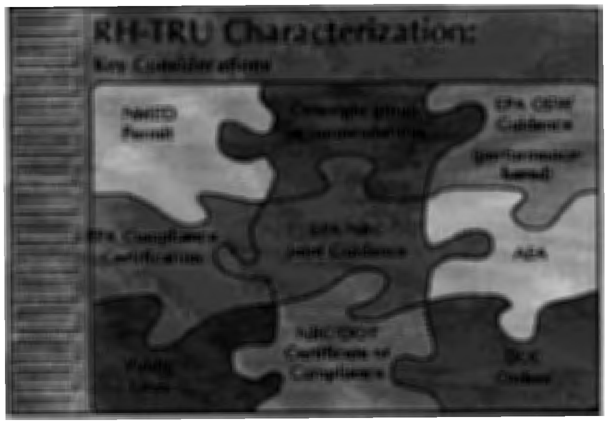
Programmatic QA

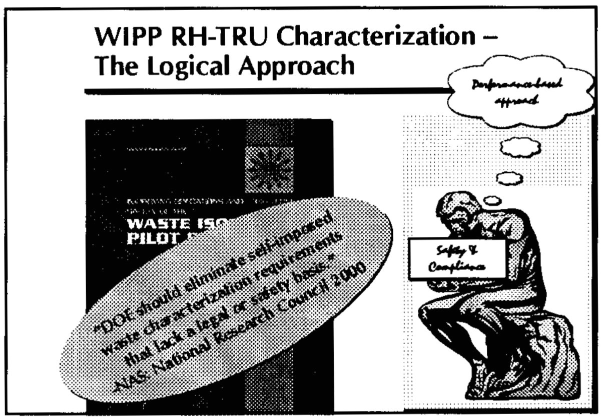
- Specified in NQA and implemented through the CAO QAPD

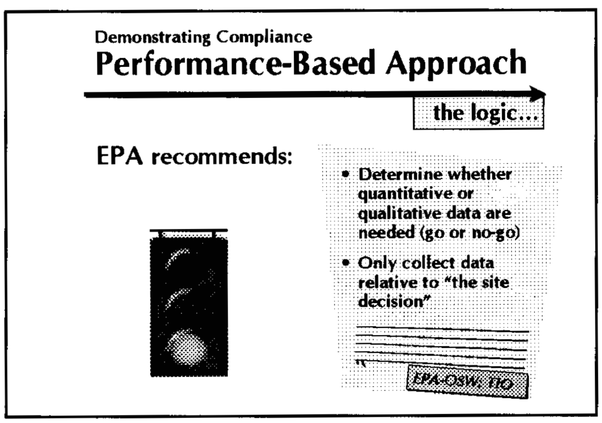
Characterization QA

- Specified in RCRA Permit, Compliance Certification, and Certificate of Compliance

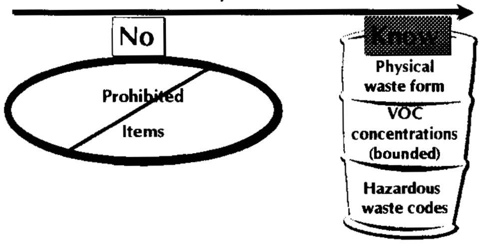



RH-TRU Characterization:


WIPP RH-TRU Characterization –
The Logical Approach
Performance-based approach
WASTE ISO
PILOT
"DOE should eliminate self-imposed waste characterization requirements that lack a legal or safety basis." NAS National Research Council 2000
Safety & Compliance


Demonstrating Compliance
Performance-Based Approach
the logic...
EPA recommends:
• Determine whether quantitative or qualitative data are needed (go or no-go)
• Only collect data relative to "the site decision"
EPA-OSW, TIO

Performance-Based Approach:
Permit Waste Analysis Plan



20 NMAC 4.1.500 (40 CFR 264.13) "analysis must contain all the information which must be known to treat, store, or dispose of the waste..."

Key Features of the
Performance-Based Approach:

- **Characterization uses Acceptable Knowledge, for example:**
  - Hazardous waste determinations required by generator state regulators
  - Process information
  - Procurement records
  - Sampling results from outside WIPP program
  - Information from surrogates
  - Information from other similar waste streams (CH or RH)

- Confirmation of AK (testing, sampling) is not required

Bounding VOC Emissions

Assumptions

- Maximum of 120 RH boreholes per room
- Release mechanisms same as closed room
- Saturated VOC concentrations in headspace

Conclusions

- RH constitutes small fraction of allowable emissions using conservative assumptions
- RH emissions can be bounded by reducing allowable emissions from CH TRU waste
- No headspace gas sampling/analysis is necessary for RH

Performance-based Approach:
Collect data that matter

A Case In Point

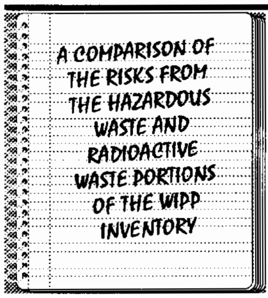
- Solidified solid sample size or required dilution due to high radioactivity results in meaningless data

the logic…

Blanket regulation of parameter-defined methods is not wise for several reasons. Eliminating flexibility forces some testing to be done inappropriately because site- specific issues (such as matrix complexities, recovery issues, or interferences) cannot be addressed.

–EPA TIO Guidance

Performance-based Approach
Comparing the Risks



VOC exposure risks ~ **4 orders of magnitude less** than those from Average radiation risks

EEG-72 July 1999

Integrating Characterization
with Radiation Safety

"Flexibility in the RCRA requirements is emphasized so that the ALARA concept can be incorporated into the mixed waste testing activities."

Joint NRC-EPA Guidance of 1997

"Indirect methods are appropriate for characterizing waste and complying with ALARA principle."

DOE G 435.1

Situations appropriate for using AK include:

"Health and safety risks to personnel would not justify sampling and analysis (e.g., radioactive mixed waste)."
EPA WAP Guidance: OSW 9938.4-03

Demonstrating Compliance
What is Relevant to RH-TRU Decision

The Logic:

RH-TRU waste - only 4% of total WIPP inventory, less than 1% of total TRU activity

- Qualitative, "go or no-go" data are all that are needed
- Radiation risks to workers do not warrant collecting data from sampling and analysis
- Data that are relative to the WIPP "site decision" (e.g., absence of prohibited items) may be obtained through AK: WIPP facility will continue to comply with the applicable disposal criteria

PERFORMANCE-BASED RH-TRU INVENTORY IMPACT ASSESSMENT

In Support of the DOE's Remote-Handled Waste Analysis Plan

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RH-Inventory Impact Analysis

- **Performance-based evaluation:** If repository performance is insensitive to upper bounds of important waste components, then total RH volume and curie content is all that is required
- **Sensitivity analysis indicate:**
  - Four radionuclides (^{241}Am, ^{238}Pu, ^{239}Pu, and ^{240}Pu) account for > 99% of the radionuclide releases
  - Three non-radioactive waste components (biodegradables, water and corrodible metal) have potential to impact repository performance

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RH-TRU Inventory Impact Assessment (RH-IA)

Model Configuration - 1

- Bounding volumes of important non-radioactive components set at 50% of RH canister internal volumes
  - Non-radioactive waste components
    - Biodegradables:
      - Plastic selected as bounding biodegradable; produces more gas per unit than other biodegradables
      - Set at 50% loading density
    - Water volume: set at 50% loading density
    - Corrodible metals: set at 50% loading density
- Radioactive waste component
  - Bounding amounts of important radioactive isotopes (^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu) set individually to full RH curie loading (1.02×10^6 Ci)

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RH Inventory of Selected Important Components

COMPONENT	CCA/BIR Rev. 3	RH-I BOUND
^{241}Am (Ci)	9.43×10^{3}	9.65×10^{5}
^{238}Pu (Ci)	1.08×10^{3}	7.6×10^{5}
^{239}Pu (Ci)	1.03×10^{4}	1.02×10^{6}
^{240}Pu (Ci)	5.05×10^{3}	1.02×10^{6}
Plastics (kg)	12.8×10^{4}	4.4×10^{6}
Corrodibles (kg)	19.1×10^{6}	43.4×10^{6}
Water (kg)	9.0×10^{4}	3.5×10^{6}

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RH-TRU Inventory Impact Assessment (RH-IA)
Model Configuration - 2

- **Two model configurations and two time frames**
  - Used CCA baseline system of codes and baseline database
  - Consider all CCA scenarios (undisturbed and human intrusion) used for CCDF construction and long-term performance during 10,000 years
  - Undisturbed only - repository evaluation using BRAGFLO during 300 years

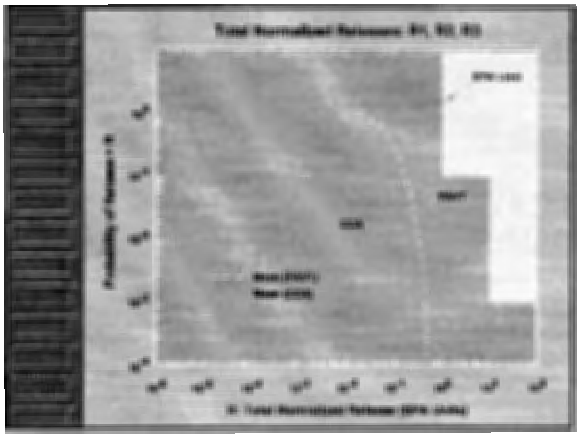
6

Analysis of RH-IA Results
^{90}Sr and ^{137}Cs do not need to be considered; negligible contribution to release

Strontium and Cesium Table of Inventory Assessment

	^{90}Sr: Total Repository Inventory Over Time		^{137}Cs: Total Repository Inventory Over Time	
Time (years)	Fraction of Total EPA Units	EPA Units	Fraction of Total EPA Units	EPA Units
0	2.5×10^{-3}	25.4	2.7×10^{-3}	27.1
100	3.5×10^{-4}	2.35	4.0×10^{-4}	2.7
350	1.5×10^{-6}	6.1×10^{-3}	2.0×10^{-6}	8.3×10^{-3}
1000	3.8×10^{-13}	1.2×10^{-9}	8.9×10^{-13}	2.5×10^{-9}
10,000	$<3.8\times10^{-13}$	$<1.2\times10^{-9}$	$<8.9\times10^{-13}$	$<2.5\times10^{-9}$

Note: TRU alpha curies at closure (calendar year 2033) is 3.44×10^{6} (10,100 total EPA units)



Analysis of RH-IA Results
Contributions To Release

- No release during undisturbed conditions
- No long-term dissolved release for human intrusion scenarios
  - Culebra retards all actinides
- Direct release during drilling is only mode of release
  - Cuttings and cavings the same as the CCA (49%)
  - Spallings next largest contributor (49%)
  - Negligible contribution to direct brine release (<2%)

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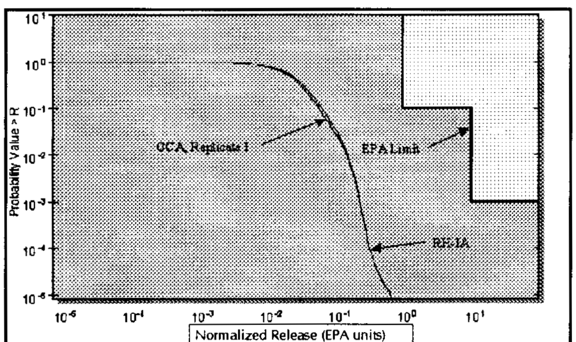

RH-IA mean CCDF total release for bounding water with comparison to CCA baseline

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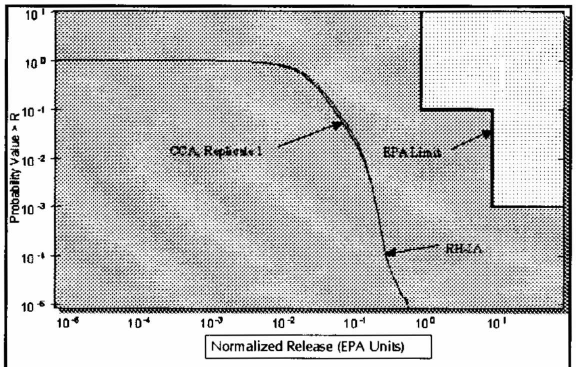
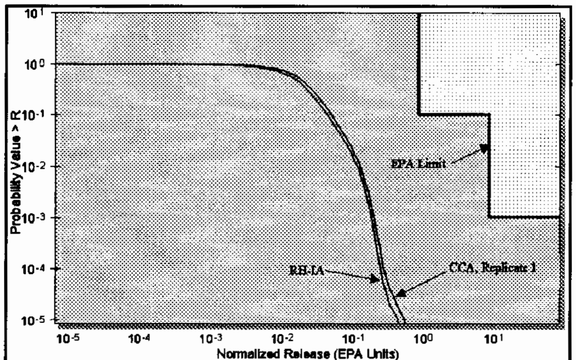


RH-IA mean CCDF total release for bounding plastics with comparison to CCA baseline



RH-IA mean CCDF total release for bounding ^{240}Pu with comparison to CCA baseline

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Analysis of RH-IA Results
300 Year Simulations

- No brine flow away from the repository/disturbed rock zone (DRZ)
  - Depressurization from excavation produces and maintains pressure gradient toward repository, not away from it
  - Insufficient gas generation to reverse this gradient during first 300 years
- No radionuclides or RCRA-regulated heavy metals leave the repository and the surrounding DRZ

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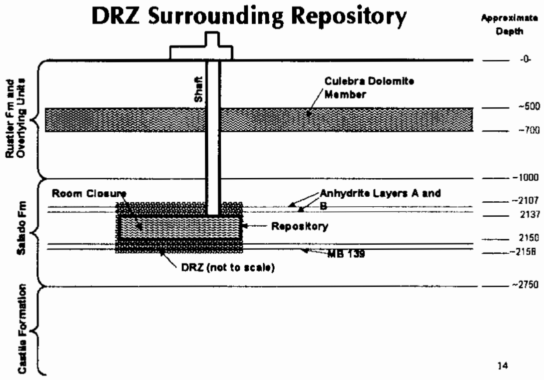
DRZ Surrounding Repository



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Summary

- Modeling results demonstrate that bounding amounts of radioactive and important non-radioactive waste components that could be emplaced in RH canister, result in a negligible impact on releases over 10,000 years; therefore total RH volume and curie content is all that is required
- In CCA and the RH-IA no brine, radionuclides, or heavy metals migrate from repository and surrounding DRZ during first 300 years after closure
- Cs and Sr have a negligible contribution to release because of small contribution to inventory and their rapid rate of decay

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Conclusions

Repository performs well even with bounding amounts of important RH waste components. Therefore, the only quantitative determination necessary is total volume and total curie content

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IMPROVING OPERATIONS AND LONG-TERM SAFETY OF THE WASTE ISOLATION PILOT PLANT

INTERIM REPORT

Committee on the Waste Isolation Pilot Plant
Board on Radioactive Waste Management
Commission on Geosciences, Environment, and Resources

National Research Council

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Although the individuals listed above have provided constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by E-an Zen, appointed by the Commission on Geosciences, Environment, and Resources, and Frank Parker, appointed by the Report Review Committee, who were responsible for making certain that an independent examination of this report was carried out in accordance with NRC procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the NRC.

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Preface

This report is the product of a National Research Council (NRC) committee study sponsored by the U. S. Department of Energy (DOE). The first NRC Committee on the Waste Isolation Pilot Plant (WIPP) began in 1978, and this committee and its successors issued eight letter reports during 1979-1992 and two full reports in 1984 and 1996. The current WIPP committee study is operating under a revised statement of task (see box) derived from a DOE request (Dials, 1997). This interim report addresses selected issues associated with the task statement, as explained below. The committee will comprehensively address the statement of task in the final report.

The specific approach taken in this interim report was to consider how to assess (1) the performance of WIPP in isolating waste from the environment and (2) the basic, minimal requirements and procedures that should be applied to waste management operations. The committee provides recommendations on several issues that it believes merit immediate consideration and action by DOE. Specifically, these issues include the determination of the natural background radioactivity in the area surrounding WIPP, and improvements in TRU waste operations.

This study is organized within the NRC's Board on Radioactive Waste Management and is being conducted by a 15-member committee. Committee members were chosen for their expertise in relevant technical disciplines such as nuclear engineering, health physics, chemical and environmental engineering, civil and transportation engineering, performance assessment, analytical chemistry, materials science and engineering, plutonium geochemistry, hydrogeology, rock and fracture mechanics, petroleum engineering, and mining engineering. As is normal practice of the National Academies, committee members do not represent the views of their institutions, but form an independent body to author this report.

To conduct the study and prepare this interim report, the committee gathered information principally through meetings and reviews of relevant literature. The committee met several times in open public sessions to hear from DOE and its contractors, as well as from other invited speakers such as regulatory agency personnel and groups with an interest in the WIPP program. Committee members prepared this report

using these inputs together with their collective knowledge and experience. The report reflects a consensus of the committee and has been reviewed in accordance with NRC procedures.

Statement of Task

The purpose of this study is to identify the limiting technical components of the WIPP program, with a two-fold goal of (i) improving the understanding of long-term performance of the repository and (ii) identifying technical options for improvements to the National TRU Program (i.e., the engineering system that defines TRU waste handling operations that are needed for these wastes to go from their current storage locations to the final repository destination) without compromising safety.

To accomplish this goal, the study will address two major issues:

(1) The first is to identify research activities that would enhance the assessment of long-term repository performance. This study would examine the performance assessment models used to calculate hypothetical long-term releases of radioactivity, and would suggest future scientific and technical work that could reduce uncertainties.

(2) The second is to identify areas for improvement in the TRU waste management system that may increase system throughput, efficiency, cost effectiveness, or safety to workers and the public. This study will examine, among other inputs, the current plans for TRU waste handling, characterization, treatment, packaging, and transportation.

Contents

Summary

The National Research Council convened a committee of experts to advise the U.S. Department of Energy (DOE) on the operation of the Waste Isolation Pilot Plant (WIPP), a geologic repository for disposal of defense transuranic (TRU) waste near Carlsbad, New Mexico. The committee was asked to provide recommendations on the following two issues: (1) a research agenda to enhance confidence in the long-term performance of WIPP; and (2) increasing the throughput, efficiency, and cost-benefit without compromising safety of the National TRU Program for characterizing, certifying, packaging, and shipping waste to WIPP.

The committee has written this interim report to provide DOE with recommendations on several issues that the committee believes merit immediate consideration and action. In developing this report, the committee has been guided by the principle of "reasonableness" with respect to risks, costs, and the ALARA (as low as reasonably achievable) principle. In the committee's judgment, implementing the recommendations contained in this report will contribute to the continued safe operation of WIPP. The committee will provide a more comprehensive response to its task statement (see the Preface) in the final report, which is scheduled for completion in the spring of 2001.

Research to Enhance Confidence in Long-Term Repository Performance

There has been extensive monitoring of radioactivity in the air, soils, fluvial sediments, surface water, and shallow groundwater in the area surrounding WIPP. However, the committee has determined that radiological baseline information is not available for subsurface brines and hydrocarbons near the WIPP site. This baseline information is important for environmental monitoring in the operational and post-operational phases of the repository.

Recommendation: The committee recommends that DOE should develop and implement a plan to sample oil-field brines, petroleum, and solids associated with current hydrocarbon production to assess the magnitude and variability of naturally occurring radioactive material

(NORM) in the vicinity of the WIPP site. Samples should be collected and analyzed for the radionuclides that will be present in transuranic waste emplaced at WIPP and the radionuclides common in NORM. These samples should be archived to permit subsequent analysis for constituents that may be of interest in the future. The committee recommends that a sampling plan be implemented prior to the closure of any underground rooms in WIPP that contain TRU waste.

Improvements to the National TRU Program

The National TRU Program is administered by the DOE Carlsbad Area Office and is designed to meet all applicable external regulations and internal requirements associated with the characterization, certification, packaging, and transportation of waste to WIPP. A reasonable goal for the National TRU Program is to send DOE TRU waste to WIPP at a minimum risk (from all sources of risk, including radiological exposure and highway accidents) and cost. The current system for managing TRU wastes does not achieve this goal. **The committee recommends that waste management procedures be reviewed and revised, with reduction of risk and cost as the guiding principles.**

The committee offers recommendations in this interim report to improve the following three aspects of the National TRU Program: (1) waste characterization and packaging requirements, (2) gas generation, and (3) the transportation system.

Waste Characterization and Packaging Requirements

The committee found inadequate legal or safety bases for some of the National TRU Program requirements and specifications. That is, some waste characterization specifications have no basis in law, the safe conduct of operations to emplace waste in WIPP, or long-term performance requirements. The National TRU Program waste characterization procedures involve significant resources (e.g., expenditures of several billion dollars) and potential for exposure of workers to radiation and other hazards. Insofar as some of this waste characterization may be unnecessary, such characterization is inconsistent with economic efficiency or the ALARA principle that guides radiation protection practices.

Recommendation: DOE should eliminate self-imposed waste characterization requirements that lack a legal or safety basis. One way to justify a reduction in waste characterization requirements is through implementation of joint U.S. Nuclear Regulatory Commission–U.S. Environmental Protection Agency guidance (62 Federal Register 62079; see Appendix B), which appears to the committee to provide appropriate guidelines for implementation and integration of Resource Conservation and Recovery Act (RCRA) requirements for mixed TRU waste. Another way to justify a reduction is to identify the origins of all waste characterization requirements and to eliminate those requirements that lack a technical or safety basis. Such reductions may require modifications to exist-

ing permits granted by external regulating authorities such as the Environmental Protection Agency and New Mexico Environment Department.

Gas Generation

The extreme assumptions used in DOE's current gas generation model results in gross overestimates of hydrogen (H_2) concentrations in waste packages to be shipped to WIPP. As a consequence, DOE plans to repackage some of the waste to dilute the hydrogen-producing components. These repackaging operations result in additional risks of radiation exposure to workers and highway accidents, the latter due to the increased number of truckload shipments required to transport waste in diluted form.

Recommendations:

1. DOE should derive a more realistic radiolytic gas generation model, validate it through confirmatory testing, use the results to recalculate gas generation limits, and seek regulatory approval to implement them.
2. DOE should perform a safety analysis to determine the concentration and quantity of hydrogen that, upon ignition, could damage the seals of the TRUPACT-II shipping container. The goal of the safety analysis would be to demonstrate whether such an event could occur inside a waste package, and whether the energy associated with such an event could result in rupturing the containment provided by the TRUPACT-II. This analysis could provide the rationale to obtain relief from the 5 percent hydrogen flammability limit and should form the basis for a future modification to the present TRUPACT-II license.
3. DOE should consider technical approaches for reducing hazards from hydrogen generation, such as filling the headspace of the waste containers or the shipping containers with an inert gas.
4. DOE should reevaluate the technical and regulatory feasibility of shipping high-wattage TRU waste using a railcar shipping system.

The goal of these recommendations is to expedite the transport of TRU waste to WIPP by increasing the amount of waste that can be safely carried in each truckload or trainload, without compromising the level of safety and containment that is provided by the shipping container. These recommended options would reduce the number of truckloads required to transport the waste to WIPP and the associated transportation risks.

Transportation Communication and Notification

DOE bases its system of communication and notification on the TRANSportation tracking and COMmunication (TRANSCOM) system, a satellite-based system initially developed more than a decade ago and used to track all DOE shipments of radioactive materials. Users have found the current level of performance of TRANSCOM to be less than

fully reliable. Although efforts are being made by DOE to keep the system current, it has not kept pace with the rapid development of information technology. As a result, the TRANSCOM system is obsolete when compared to presently available communications systems.

Recommendations: DOE should consider cost-effective ways to improve the reliability and ease of use of the TRANSCOM system, either by improving or replacing it. If DOE decides to replace the current system, the committee strongly encourages the use or adaptation of existing commercial systems. In the near term, the DOE should develop an interim plan for maintaining an adequate communication and notification system until any such alternative system or TRANSCOM upgrade is ready for full-scale implementation. This plan should be driven by a comprehensive assessment of TRANSCOM component performance based on anticipated usage. In the long term, DOE should ensure that the system it employs is designed to meet the needs of WIPP shipment users and other major stakeholders in a timely and cost-effective fashion.

Transportation Emergency Response

The responsibility for emergency response is divided between DOE and the states along WIPP shipment corridors. In the committee's view, a system to maintain up-to-date information on response capability would contribute significantly to the effectiveness of the transportation system. The WIPP emergency response program has not assessed sufficiently whether adequate and timely emergency response coverage for a transportation incident exists along the full extent of each WIPP route. No formal system presently exists to identify areas where coverage may be inadequate.

Recommendations: The committee recommends that DOE explore with states and other interested parties how to develop processes and tools for maintaining up-to-date spatial information on the location, capabilities, and contact information of responders, medical facilities, recovery equipment, regional response teams, and other resources that might be needed to respond to a WIPP transportation incident. This assessment should explore which organization(s) should develop and maintain the capability to generate and maintain such information. DOE should also determine where emergency response capability is currently lacking, identify organization(s) responsible for addressing these deficiencies, and take action to address them.

Introduction

The Waste Isolation Pilot Plant (WIPP)[1] is a series of excavations in a Permian-age bedded salt formation approximately 660 m below the surface near Carlsbad, New Mexico (see Figure 1). Since the mid-1970s, this site has been studied for use as a geologic repository for the disposal of transuranic[2] (TRU) waste resulting from the nation's defense program. This waste contains transuranic isotopes, predominantly plutonium isotopes, which are characteristically long-lived radionuclides and therefore a long-term safety hazard. Removing these wastes from the biosphere, for example, through isolation in geologic repositories, is an appropriate strategy for protection of human health and the environment.

At WIPP, packaged waste is disposed by emplacing it in rooms excavated in the salt. Because salt under pressure flows (or "creeps") and because of the underground pressure exerted on the room ceiling, floor, and walls, over time the salt rock at these surfaces will consolidate around the waste. In time, the salt heals so as to be essentially impermeable, isolating the waste-filled rooms from the rest of the environment.

WIPP is the first deep geological repository that has been designed and engineered for radioactive waste disposal and approved by an external regulatory authority. Operations at WIPP to receive TRU waste and emplace it underground began in 1999, when TRU waste shipments were received from three U.S. Department of Energy (DOE) sites. Drums of TRU waste from the Los Alamos National Laboratory, the Idaho National Engineering and Environmental Laboratory, and the Rocky Flats Environmental Technology Site were first sent to WIPP in March, April, and June 1999, respectively.

The committee has prepared this report to provide findings and recommendations that it considers important for the safe and cost-effective operation of WIPP. The perspective of the committee has been the establishment of "reasonableness" with respect to risks, costs, and the ALARA (as low as reasonably achievable) principle (see footnote 8). The committee believes that the implementation of these recommendations will contribute to the continued safe operation of WIPP.

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[1]A complete list of acronyms used in this report appears in Appendix D.

[2]Transuranic waste contains radionuclides with atomic numbers greater than 92 and half-lives greater than 20 years in concentrations exceeding 100 nanocuries per gram.

As noted in the preface to this report, the first component of the statement of task is "to identify research activities that would enhance the assessment of long-term repository performance" (see Appendix A). The committee considers that data from radiological site characterization measurements would provide a necessary baseline to compare against future measurements, should the integrity of WIPP ever be challenged. This issue is explored in the next section.

The second component of the statement of task pertains to improvements of the DOE TRU waste management system. To address this issue, the committee sought to identify the technical, regulatory, legal, and/or safety bases of waste management activities that significantly impacted the overall system throughput, efficiency, cost, and safety. These issues are addressed in the last section of this report.

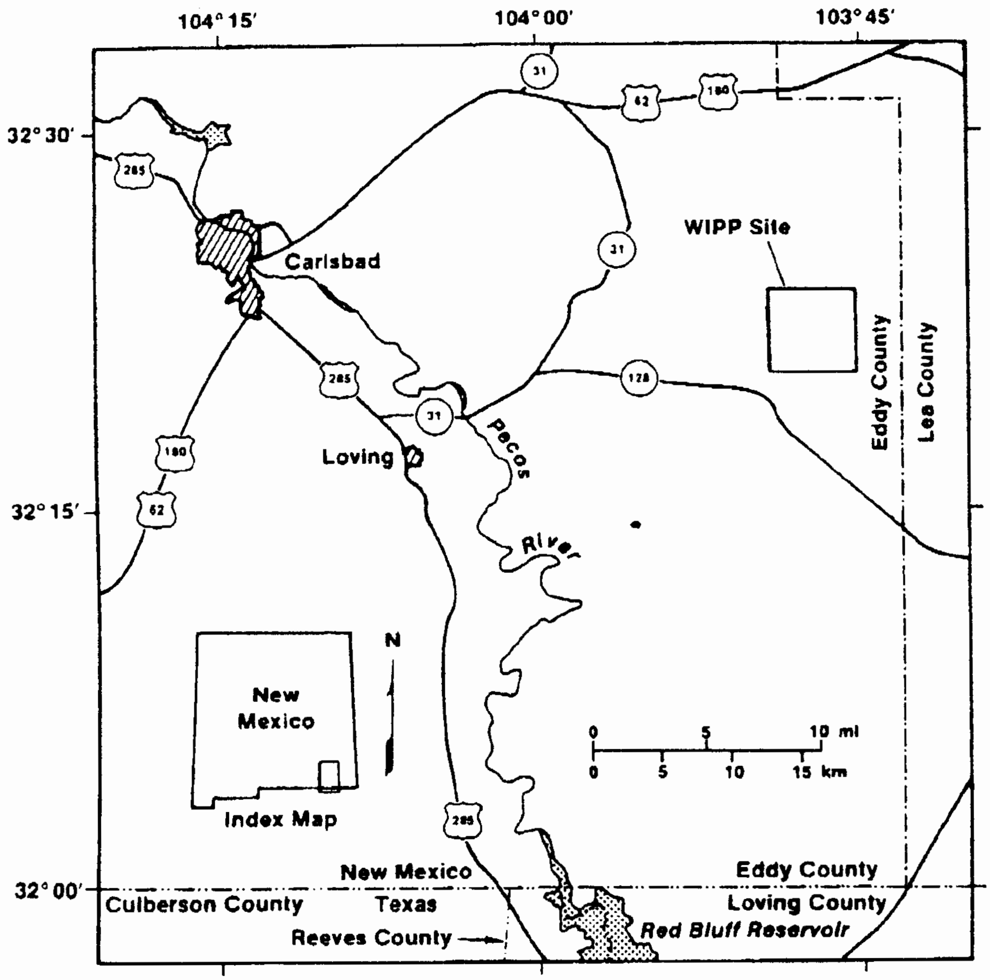

FIGURE 1 Location of the Waste Isolation Pilot Plant. Inset shows the approximate location of the map area in New Mexico. SOURCE: NRC (1996, Figure 1.1.).

Baseline Radiogenic Analysis of Subsurface Fluids

In this section the committee provides recommendations on research activities to enhance confidence in the long-term performance of WIPP. In particular, the committee considered how "baseline" studies undertaken during the early phases of repository operation could be used to support future efforts to assess repository performance.

Finding: There has been extensive monitoring of radioactivity in the air, soils, fluvial sediments, surface water, and shallow groundwater in the area surrounding WIPP.[3] However, the committee has determined that radiological baseline information is not available for subsurface brines and hydrocarbons near the WIPP site. This baseline information is important for environmental monitoring in the operational and post-operational phases of WIPP.

Recommendation: The committee recommends that DOE should develop and implement a plan to sample oil-field brines, petroleum, and solids associated with current hydrocarbon production to assess the magnitude and variability of naturally occurring radioactive material (NORM) in the vicinity of the WIPP site. Samples should be collected and analyzed for the radionuclides that will be present in transuranic waste emplaced at WIPP and the radionuclides common in NORM. These samples should be archived to permit subsequent analysis for constituents that may be of interest in the future.[4,5] The committee recommends that a

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[3]See, for example, Conley (1999); DOE (1997c); Herczeg et al. (1988); and Kenney et al. (1999). Additionally, previous Environmental Evaluation Group studies on radiation monitoring of air, surface soil, and biota samples near the WIPP site include Neill et al. (1998); Kenney et al. (1990, 1995, 1998); Kenney and Ballard (1990); and Kenney (1991, 1992, 1994). Ramey (1985) summarizes U.S. Geological Survey data on simple radiological characterization (i.e., gross alpha, gross beta, dissolved radium, and dissolved uranium) of fluids in the Rustler Formation. References to other studies are contained in annual reports of the Carlsbad Environmental Monitoring Research Center (CEMRC, 1999) and on the CEMRC website, http://www.cemrc.org.

[4]A reanalysis of a sample using a different detection method could yield a different value. These detection limitations should be understood and distinguished from true natural differences in background radiation.

sampling plan be implemented prior to the closure of any underground rooms in WIPP that contain TRU waste.

Rationale: Early studies discounted the potential for hydrocarbon production in the vicinity of WIPP, but over the past 20 years this way of thinking has changed dramatically. The site is now surrounded by wells (see Figure 2) for hydrocarbon production (Broadhead et al., 1995), and drilling activities continue. Furthermore, it is relatively common for brines associated with hydrocarbons to be radiogenic (Bloch and Key, 1981; Fisher, 1995). Oil-field brines in the Delaware Basin share this property (Fisher, 1995). The information available on oil-field brines and petroleum resources generally consists of gross radiation measurements (i.e., gross activity), rather than analytical data on the radionuclide constituents. Such analytical data on the radioactivity of oil-field brines and petroleum resources at the WIPP site have not been made available to the committee and may not exist.

If, during or after WIPP operations, increased radioactivity in the vicinity of WIPP is observed, is this the result of a failure of the WIPP to contain its waste, or is it due to NORM? This question cannot be answered easily unless the oil-field brines, petroleum, and solids associated with hydrocarbon production (e.g., suspended solids, precipitated scale, sludges, and formation fragments) are analyzed for their naturally occurring radiation. Analyses for radioactivity and radionuclides will be necessary if disputes arise about potential releases of radionuclides from the repository. An example of the need to obtain adequate NORM background data already has been observed with occurrences of natural surface contamination on the exterior of truck transportation packages while en route to WIPP during the first three months of operation.

"Human intrusion scenarios" involving hydrocarbon exploration and production are now considered processes through which radionuclides might be released from WIPP (Kirkes, 1998). If brines have a measurable NORM content, then human intrusion that results in brine flow through WIPP to the surface is a means by which radioactivity could be carried to the surface that is not due to the TRU waste emplaced in WIPP. If oil-field brine NORM is present, then it is conceivable that NORM releases would be greater than releases from the TRU waste contents of WIPP, even if drilling breaches the repository.

Transport and disposal of oil-field brines that have high NORM contents are also potential mechanisms for localized increases in radiation. Any such increases in radiation in the vicinity of WIPP cannot necessarily be attributed to WIPP operations or the failure of WIPP to contain its waste.

There are data suggesting that oil-field brines near WIPP might contain NORM. Otto (1989, reproduced in Fisher, 1995; see Figure 3)

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[5]The archiving of monitoring data, as well as samples, is also a long-term challenge due to the evolution of information technology and the changes in state-of-the-art storage media that will likely take place over the three decades in which WIPP is projected to be open and operational. Any data records not in paper form would be subject to such challenges.

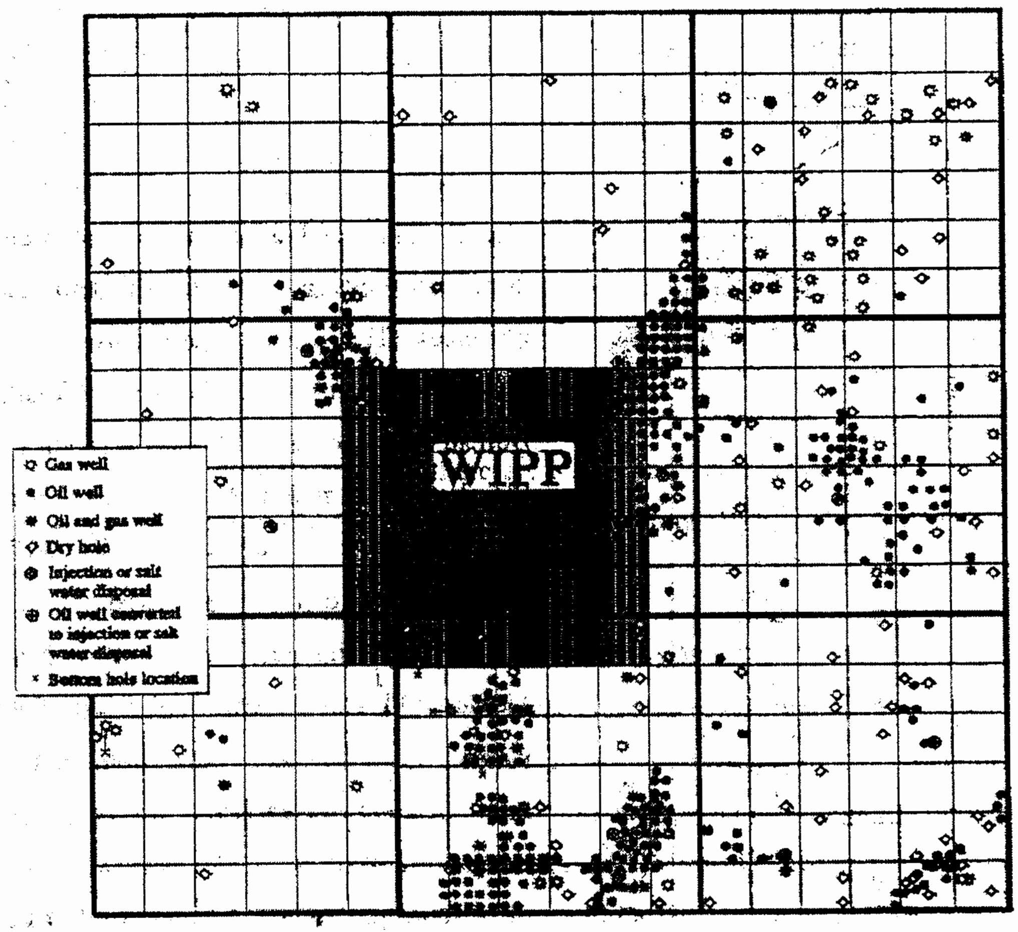
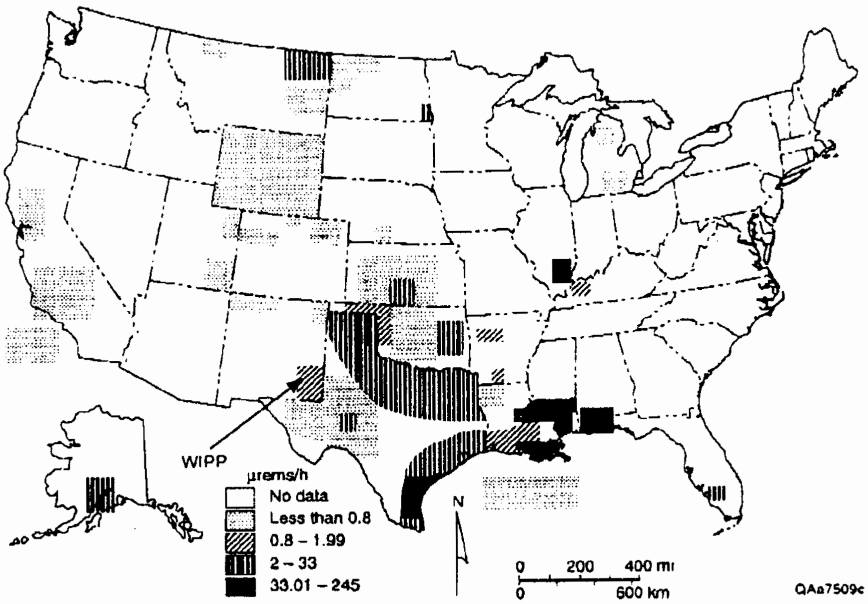


FIGURE 2 Petroleum wells in the vicinity of the WIPP site. See Figure 1 for an inset map showing the WIPP site's approximate location within New Mexico. SOURCE: Silva (1996, p. 24).

(a)



(b)

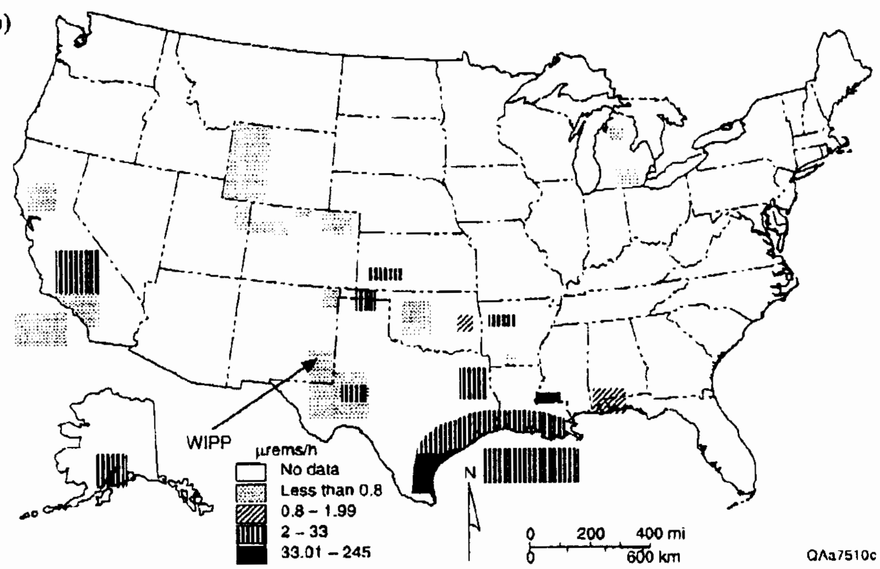


FIGURE 3 Regions of high activity from NORM in the United States from (a) oil-producing facilities and (b) gas-producing facilities. Values are aggregated median differences over background. The legend shows various shadings corresponding to various ranges of dose rates measured in microrems per hour (µrem/h). These dose rates are radioactivity measurements of NORM deposits in piping and in fluids brought to the surface. These measurements describe the concentration of radioactive species, a characteristic of the NORM deposits at any locality that is not directly dependent on the local production rate (of hydrocarbons or brine) or on the amounts of fluid that were extracted to produce the deposits. SOURCE: Fisher (1995), after Otto (1989).

shows the Delaware Basin of southeast New Mexico as a region of NORM activity in oil-and gas-producing facilities. Fisher states that "(1) not every major oil or gas field has associated high NORM levels, and (2) no major hydrocarbon-producing basin in Texas is exempt from high levels of radioactivity." The major hydrocarbon-producing basins in Texas described by Fisher include the Delaware Basin, which contain producing formations near the WIPP site, and the adjacent Central Basin Platform (Hill, 1996, p. 26).

In response to committee requests for information, DOE has answered that no data have been collected on "naturally occurring radionuclides in the underground brines and hydrocarbons near WIPP by DOE. In addition, DOE is unaware of any related information collected by the oil and gas industry" (Mewhinney, 1998b).

The need for these data is clear—no effective monitoring of the WIPP area can be successful without understanding potential sources of radiation in the environment. Air, soils, sediments, ground and surface waters, biota, and people have been analyzed to provide a database (e.g., through CEMRC activities). NORM from local hydrocarbon operations must also be analyzed. The NORM data will

- identify sources of future contamination events that might (wrongly) be attributed to a failure of WIPP;
- place any radioactivity releases from human intrusion scenarios (e.g., from petroleum exploration and production) in perspective; and
- improve the monitoring efforts.

The committee recommends near-term action to collect and analyze these data based on an appropriate sampling plan. The plan must include frequency of sampling and analyses; radionuclides to be analyzed; collection of data to assess NORM radioactivity and to estimate its variability; sampling, analysis, and archiving protocols; and producing formations to be tested. These formations should include both past (if applicable) and present producing zones, new producing zones as they become exploited in the future, and formations from which brine is (or likely will be) extracted.

Samples could come from ongoing well-based operations that generate separator streams of oil, gas, and water. These separators and separator streams are owned by the operators of the leases. The drilling of new wells would be justified if data from separator streams prove to be inadequate.

The radionuclides of interest include both those that contribute to the site's NORM background radioactivity and those in the DOE TRU inventory destined for WIPP. The NORM activity may include contributions from potassium-40, isotopes of uranium and thorium, and daughter products such as isotopes of radium. Radionuclides in TRU waste include isotopes of uranium and TRU elements and, in remote-handled[6] TRU

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[6]Remote-handled waste is classified as that with a surface dose rate greater than or equal to 200 mrem per hour. Such waste contains fission products and activation products such as cobalt-60, strontium-90, yttrium-90, ruthenium-106,

waste, fission and activation products. Since some TRU inventory radionuclides are not commonly found in nature, sampling to determine whether such radionuclides are present in the environment may be a good way to distinguish radioactivity due to NORM from that due to TRU waste.

For the reasons given above, the committee supports the collection of NORM data on deep subsurface fluids, even though the isotopic signatures of NORM and TRU waste radioactivity are expected to differ and therefore to be readily distinguishable. In the committee's view, DOE would be better served to possess these NORM data prior to any reported discovery of significant radioactivity in the region; hence, in its recommendation the committee proposes that this survey to sample deep subsurface fluids be conducted in the near term. This survey need not continue once the measurement objectives, as proposed in this recommendation, have been met.

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cesium-137, barium-137, and europium-152. These and other radioisotopes emit penetrating beta and gamma radiation that requires shielding.

Transuranic Waste Management Program

Transuranic waste management operations are performed under the auspices of the DOE National TRU Program administered by the DOE Carlsbad Area Office. This program has been designed and developed, based on initial efforts in the 1980s and subsequent modifications, to accommodate all applicable external regulations and internal requirements that are associated with the characterization, certification, packaging, and transportation of TRU waste to WIPP. These procedures, described briefly in Appendix A, were applied in 1999 for the first contact-handled TRU waste shipments to WIPP from DOE sites that have generated and stored such waste. The remote-handled TRU waste management system is still under development and is not reviewed in this report.

The committee considered three topics associated with TRU waste management: (1) waste characterization and packaging requirements, (2) gas generation, and (3) transportation. These topics are discussed in the following subsections.

Waste Characterization and Packaging Requirements

Finding: The committee found inadequate legal or safety bases for some of the National TRU Program requirements and specifications. That is, some waste characterization specifications have no basis in law, the safe conduct of operations to emplace waste in WIPP, or long-term performance requirements.[7] The National TRU Program waste characterization procedures involve significant resources (e.g., expenditures of several billion dollars) and potential for exposure of workers to radiation and other hazards. Insofar as some of this waste characterization may be unnecessary, such characterization is inconsistent with economic efficiency and the ALARA principle that guides radiation protection practices.[8] The committee regards the 30+ years of waste emplacement op-

[7]A recent study (DOE, 1999c) has also shown that some waste characterization procedures are not prescribed by safety or legal requirements.

[8]ALARA requires that all operations be done with the lowest possible radiation exposure consistent with other requirements of safety and basic programmatic objectives. See, for example, 10 CFR 835, which are requirements for

erations and related worker safety issues at WIPP as posing no significant needs for waste characterization information, because no use of characterization data is made in any handling, shipping, or emplacement operations.

Recommendation: DOE should eliminate self-imposed waste characterization requirements that lack a legal or safety basis. One way to justify a reduction in waste characterization requirements is through implementation of joint U.S. Nuclear Regulatory Commission (USNRC)–U.S. Environmental Protection Agency (EPA) guidance (62 Federal Register 62079; see Appendix B), which appears to the committee to provide appropriate guidelines for implementation and integration of Resource Conservation and Recovery Act (RCRA) requirements for mixed TRU waste. Implementation of this regulatory guidance could significantly reduce the testing protocols and associated radiation exposure of personnel. Another way to justify a reduction is to identify the origins of all waste characterization requirements and to eliminate those requirements that lack a technical or safety basis. Such reductions may require modifications to existing permits granted by external regulating authorities such as the EPA and New Mexico Environment Department.

Rationale: The National TRU Program has developed waste restrictions, as described in the waste acceptance criteria (DOE, 1996a, 1999d), and requirements for waste generating sites presented in the quality assurance program plan (DOE, 1998b). These criteria and plans impose many required procedures on waste-generating sites. EPA and DOE Carlsbad Area Office audits are conducted to certify (i.e., approve for shipment) TRU waste streams. Additionally, each container of waste from a certified waste stream must be characterized, and shipping sites must prepare documentation on characterization data for each waste container. At the Los Alamos National Laboratory, the time to obtain all the requisite documentation and administrative approvals was greater than the time to process a drum of waste through the characterization and packaging protocols that had been developed. At all sites, the assembly, management, and storage of waste characterization information are resource-intensive activities, and drum handling is a major source of worker exposure. Of interest to the committee is the origin of these required procedures, because they increase the cost or risk or decrease the efficacy of operations.

The committee sought to identify the connection between the National TRU Program procedures and the various regulatory, legal, and technical requirements that the procedures should be devised to meet. The committee views these requirements in a hierarchy, at the top of which are legal and safety requirements, with regulatory specifications at the next tier, procedures proposed by DOE to meet regulatory requirements at the third tier, and the DOE protocols for these procedures at the fourth tier.

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worker protection referenced in DOE radioactive waste management practices (specifically, in DOE Order 435.1 [DOE, 1999a]).

The approach used by the committee was to focus on six primary National TRU Program procedures representative of high-level requirements that drive operational activities in waste characterization and repackaging (see Appendix A for an overview of these activities):[9]

1. determination that the TRU waste is of defense origin;
2. sampling and analysis of homogeneous waste;
3. headspace gas sampling and analysis;
4. radioassay of the plutonium content;
5. real-time radiography; and
6. visual examination.

These procedures are incorporated into the terms of the WIPP facility's RCRA "Part B" permit, which was issued in October 1999. The EPA guidelines that are specific to RCRA requirements are presented in Appendix B. However, the committee notes that the permit terms are subject to negotiation in a regulatory permitting process, based on the procedures proposed by DOE that became accepted as meeting regulatory requirements. A recent study (DOE, 1999c) has traced these and other TRU waste characterization requirements to their root origins in either (1) Carlsbad Area Office mandates, (2) regulatory certification and permit terms, (3) regulatory requirements or DOE orders, or (4) legal requirements.

A review of these six procedures revealed that one may be interpreted too strictly by DOE and three are without a technical or legal foundation:

Procedure 1: Determination that the TRU waste is of defense origin. WIPP is limited to defense-related waste as stipulated in the Land Withdrawal Act, with defense activities defined in the Nuclear Waste Policy Act of 1982. The committee notes that this definition includes the words "in whole or in part", which can be interpreted to include mixtures of defense and nondefense waste, although DOE does not appear to take advantage of this (see DOE, 1997a; Nordhaus, 1996). That is, waste such as plutonium-238 (^{238}Pu)-contaminated scrap from a facility used for both defense and nondefense missions at Los Alamos National Laboratory would appear to qualify as defense waste under the definition, without the need for waste segregation restrictions.

Procedure 2: Sampling and analysis of homogeneous waste. DOE has written, "There is no regulatory requirement to conduct homogeneous waste sampling and analysis, however, in an effort to meet the intent of 40 CFR 264.13, WIPP has imposed additional characterization requirements on the waste generators" (Nelson, 1999a, p. 2). No operational decisions are made based on these data; that is, the results of the sampling and analysis do not affect how waste is handled, so it is not clear what justifies the additional radiation exposure risk and cost of this procedure. In the committee's view, this sampling and analysis applied only to homogeneous waste is unnecessary: If acceptable knowledge documentation

[9] A more comprehensive list of TRU waste characterization procedures and their origin is found in DOE (1999c).

(see Appendix A) provides sufficient characterization information for heterogeneous waste, the committee can identify no technical reason why acceptable knowledge should not also be adequate for homogeneous waste.

Procedure 3: Headspace gas sampling and analysis. DOE informed the committee that "there is no regulatory requirement to conduct headspace gas sampling and analysis, however, in an effort to meet the intent of 40 CFR 264.13, WIPP has imposed additional characterization requirements on the waste generators" (Nelson, 1999a, p. 3). The headspace gas sampling and analysis was developed as a means of checking on conformance with USNRC and the U.S. Department of Transportation (DOT) requirements (see Appendix A for relevant sections of these regulations); however, these requirements can be met by other means (see the recommendations that follow on the issue of gas generation).

Procedure 6: Visual examination. Visual examination is done on a fraction of the waste containers to confirm the real-time radiography and acceptable knowledge waste characterization information (Nelson, 1999a, p. 5). However, there is no requirement for verification of real-time radiography results. An alternative way to confirm these results without operator exposure would be to use standardized test drums. The visual examination confirmation is a self-imposed procedure that yields no benefit but results in increased risk of exposure and cost.

A DOE study (1999c) also confirms that procedures 2, 3, and 6 identified above are based on terms negotiated in a permit and not on a required regulation or legal mandate. The committee sees no utility in the information that these procedures provide. Any speculative benefits of acquiring this information must be weighed against the risks and costs. The committee's judgment is that the collection of these data from superfluous procedures increases, rather than decreases, the risk and safety of the overall TRU waste operations.

These superfluous characterization and intrusive procedures also represent a conflict with the ALARA principle. The issue of how to handle conflict between regulatory requirements for waste characterization information and ALARA is beyond the scope of the committee's statement of task. At issue, however, is whether the present TRU waste management program results in significantly more worker radiation exposure than is justified to satisfy safety and nonnegotiable regulatory requirements.

Gas Generation

Finding: The extreme assumptions used in DOE's current gas generation model result in gross overestimates of hydrogen concentrations in waste packages to be shipped to WIPP. As a consequence, DOE's plans to repackage some of the waste to dilute the hydrogen-producing components. These repackaging operations result in additional risks of radiation exposure to workers and highway accidents due to the increased number of truckload shipments required to transport waste in diluted form.

Recommendations:

1. DOE should derive a more realistic radiolytic gas generation model, validate it through confirmatory testing, use the results to recalculate gas generation limits, and seek regulatory approval to implement these limits.

2. DOE should perform a safety analysis to determine the concentration and quantity of hydrogen that, upon ignition, could damage the seals of the TRUPACT-II shipping container. The goal of the safety analysis would be to demonstrate whether such an event could occur inside a waste package, and whether the energy associated with such an event could result in the rupture of containment provided by the TRUPACT-II. This analysis could provide the rationale to obtain relief from the 5 percent hydrogen flammability limit and should form the basis for a future modification to the present TRUPACT-II license.

3. DOE should consider technical approaches for reducing hazards from hydrogen generation, such as filling the headspace of the waste containers or the shipping containers with an inert gas to displace air and thereby reduce the flammability hazard.

4. DOE should reevaluate the technical and regulatory feasibility of shipping high-wattage TRU waste using ATMX[10] railcar shipping system.

The goal of these recommendations is to expedite the transport of TRU waste to WIPP by increasing the amount of waste that can be carried safely in each truckload or trainload, without compromising the level of safety and containment that is provided by the shipping container. These recommended options would reduce the number of truckloads required to transport the waste to WIPP and the associated transportation risks.

Rationale: The amount of TRU waste in each waste drum and truck shipment is limited because of the potential for radiolytic generation of hydrogen gas (H_2). Within TRU waste, radiolytic hydrogen gas generation is due primarily to the co-disposal of alpha emitters with organic materials. The DOE has developed a radiolysis model to calculate hydrogen generation rates and the hydrogen concentration in each headspace[11] inside a waste container. Limiting any H_2 concentration to 5 percent leads to a restriction, expressed as maximum allowable wattage, on alpha activity (i.e., the amount of alpha-emitting radionuclides) within each waste container (e.g., a 55-gallon drum). The value of 5 percent H_2 (as a mole

[10] "ATMX" is an acronym to denote the railcars used by DOE to ship nuclear weapons components and TRU waste. The "AT" stands for Atchison Topeka, the rail carrier. The "M" signifies munitions, and the "X" on a railcar signifies private ownership (in this case, by the U.S. government), rather than ownership by the railroad company. As noted elsewhere in this report, these railcars have been used to ship TRU waste for decades.

[11] In many waste containers, waste is contained in one or more plastic bags that were used for radiological protection against any inadvertent spread of radioactivity. These plastic bags provide resistance to diffusive transport of hydrogen gas, thereby providing multiple headspaces.

fraction) in air as a "flammability limit" can be used in any USNRC license application on a transportation package without the need for further safety analysis because of its conservatism. This allowable wattage is a function of the G value[12] of the solid matrix of the waste materials adjacent to each alpha emitter and the total resistance to the flow of hydrogen gas that the waste and packaging contents provide, due primarily to the layers of plastic bags in the waste.

Wattage limits based on this model determine whether or not a waste container may be transported to WIPP without repackaging. The gas generation model, and the wattage limits derived from it, specify the terms of operation that are contained in the DOE safety analysis report for the TRUPACT-II transportation package. These terms of operation are also specified in DOE's application to the USNRC for regulatory approval of the TRUPACT-II transportation package. The certificate of compliance for TRUPACT-II issued by the USNRC is subject to modifications (and in fact has been amended several times since the original certificate was issued in the late 1980s), provided that DOE can offer sufficient adequate safety assurances and comply with applicable regulations, principally the USNRC's 10 CFR 70-71 and DOT's 49 CFR 171-173.

The current model is based on worst-case scenario of H_2 generation and wattage limits. Because of this worst-case approach and the extreme assumptions used in the model, the calculations often exceed experimental observations by orders of magnitude. The explanations for these large discrepancies are only beginning to be studied (see Idaho Engineering and Environmental Laboratory, 1998; Mewhinney, 1998a). Specific examples follow.

1. A G value of 3.4 is used for the plastic bags in the safety analysis report for the TRUPACT-II (DOE, 1997b). In this analysis, no credit is taken for matrix depletion (i.e., exhaustion of the H_2 source). Therefore, DOE is seeking relief from unrealistically large G values in revisions 17-19 of the safety analysis report and certificate of compliance for the TRUPACT-II (DOE, 1999b).

2. The model assumes that all layers of plastic bags are intact and behave as a new bag (i.e., no credit is taken for changes in permeability with age).

The results of these gas generation model assumptions have severe consequences.[13] Repackaging is carried out to redistribute waste in containers (e.g., 55-gallon drums) in order to meet the wattage limits derived from the gas generation model for each container. This repackaging of waste exposes workers to radiation and increases the number of containers, thereby diluting the waste into a greater volume.

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[12]The G value is the number of electrons (or, equivalently, the number of electron-ion pairs, with H^+ the chief ion produced in materials containing hydrogen compounds) produced in a material per 100 eV of energy that is deposited within it by irradiation.

[13]In general, the use of extreme assumptions that result in overestimating consequences is not a conservative approach, because attending to these overestimated consequences results in unnecessary actions, each of which has its own risks, thus potentially increasing the risks of the overall operations.

Transportation-related risks (and costs) are also incurred in repackaging, because the extra containers require additional shipping loads with many additional truck trips. DOE estimates reveal that this repackaging of ^{238}Pu contact-handled TRU waste may increase the number of ^{238}Pu shipments by more than a factor of ten, to as many as 150,000 extra drums (Lechel and Leigh, 1998).[14] Another consequence of such volume expansions that should be considered is the impact on WIPP's volume limit.[15] Therefore, the maximum allowable wattage imposed by the gas generation model is a major technical restriction of the National TRU Program.

Recent information (DOE, 1999b; Gregory, 1999) suggests that significant progress is being made toward developing technical information to support planned future applications to the USNRC to amend the terms of the TRUPACT-II safety analysis report and certificate of compliance. Research continues to investigate the use of hydrogen getters[16] (Mroz et al., 1997, 1999), methods for puncturing bags, use of vented bags (Gregory, 1999), and relief from the restrictive G values (Idaho Engineering and Environmental Laboratory, 1998).

To provide containment of its radioactive contents, the TRUPACT-II shipping container uses outer O-rings that generate a vacuum seal. In this package design, internally generated gas, such as H_2, builds up to pressurize the internal gas volume. Other transportation package designs are possible that are less sensitive than the TRUPACT-II to the potential for H_2 gas generation. One such system for transport of TRU wastes was the ATMX railcar system, which DOE used for hundreds of shipments over several decades to safely transport TRU waste from the Mound Laboratory in Ohio and from the Rocky Flats Environmental Technology Site in Colorado to the Idaho National Engineering and Environmental Laboratory. Based on the integrity provided by the railcar, this system was exempted (DOT exemption number DOT-E 5948) from the double-containment and vacuum seal requirements for packages used to transport plutonium (classified as "Type B" fissile packages). As a result, this system did not suffer limitations of the kind that are imposed on the TRUPACT-II due to radiolytic gas generated and trapped within the shipping container.

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[14]The actual number of containers to be repackaged and procedures to be used have not yet been determined by DOE but are under active study, as is an analysis of technical options. If each truck carried the maximum number of TRUPACT-II transporters per shipment to WIPP, and each TRUPACT-II carried the maximum number of 55-gallon drums, 150,000 drums would be equivalent to 3,600 additional truck shipments.

[15]The Land Withdrawal Act (P.L. 102-579) specifies a total TRU waste volume limit of 175,600 m^3; if waste were sufficiently diluted, WIPP would be filled to this volume limit without having disposed the total TRU inventory in curies. Therefore, there is a minimum "filling ratio" of curies to volume that must be achieved, on average, for WIPP to contain the total TRU inventory in curies by the time the volume restriction is reached.

[16]A getter is a material designed to absorb gas such as hydrogen.

Transportation

The committee has examined various aspects of the WIPP transportation system, focusing on system safety and the cost-effectiveness of planned and ongoing activities. Based on this review (see DOE, 1999b; Mewhinney, 1998a,b), the committee has identified two issues—DOE's communication and notification system (TRANSCOM[17]) and DOE's emergency response program—that warrant immediate attention.

DOE's Communication and Notification Program

Finding: DOE bases its system of communication and notification on TRANSCOM, a satellite-based system developed more than a decade ago and used to track all DOE shipments of radioactive materials. Users have found the current level of performance of TRANSCOM to be less than fully reliable. Although efforts are being made to keep the system current (Nelson, 1999b), it has not kept pace with the rapid development of information technology. As a result, TRANSCOM is obsolete compared to presently available communications systems (for a summary of recent transportation communication initiatives using information technology, see Allen [1998]).

Recommendations: DOE should consider cost-effective ways to improve the reliability and ease of use of the TRANSCOM system, either by improving or replacing it. If DOE decides to replace the current system, the committee strongly encourages the use or adaptation of existing commercial systems. In the near term, DOE should develop an interim plan for maintaining an adequate communication and notification system until any such alternative system or TRANSCOM upgrade is ready for full-scale implementation. This plan should be driven by a comprehensive assessment of TRANSCOM component performance based on anticipated usage. In the long term, DOE should ensure that the system it employs is designed to meet the needs of WIPP shipment users and other major stakeholders in a timely and cost-effective fashion.

Rationale: Public confidence in a transportation communication and notification system is essential. This will become increasingly important with the growing number of shipments to WIPP. The magnitude of shipping activity and the public interest in WIPP transportation safety dictate the need for a state-of-the-art communications system.

As a means of obtaining information on the current effectiveness of TRANSCOM, the committee contacted 27 users located across the nation, requesting information on their experience with the system. Serious concerns were raised about system reliability and ease of use, giving the impression that key transportation stakeholders have little confidence in TRANSCOM. Comments of the 11 users who responded (from two tech-

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[17]The DOE TRANSportation Tracking and COMmunication System, or TRANSCOM, is a satellite-based telecommunications system designed to enable users to track WIPP truck shipments in essentially real time while en route to WIPP on the approved highway routes.

nology companies and various institutions involved in emergency response monitoring in Colorado, Illinois, Pennsylvania, Idaho, Wyoming, Oregon, Arizona, North Carolina, and Utah) to a committee survey are shown below. On a scale of 1 to 5, with 1 = inadequate, 2 = poor, 3 = average, 4 = good, and 5 = excellent, the average scores for TRANSCOM system on five issues were as follows:

Category	Average Score on Scale of 1 to 5
Accuracy	3.5
Cost	3.4
Ease of use	3.2
Communication capability	3.0
Reliability	2.5

Most survey responders also wrote either explicitly or by using examples that the system was (1) unreliable (citing frequent downtime, connection or access problems, or other hardware or software problems), (2) not user friendly (citing features such as slow data rates, the time required to download information, and "old technology"), and (3) not economical because of the high costs for modem connections. Of those survey responders who had experience with at least one other transportation tracking system, each provided written comments attesting to the "unreliable" and/or "not user-friendly" features of TRANSCOM.

The committee concludes from this survey and from other materials received (e.g., presentations at committee meetings in October 1998, May 1999, and July 1999) that the TRANSCOM system has failed to give its users confidence in its reliability, ease of use, and the timeliness with which accurate information can be accessed. The committee regards these features as important for engendering public confidence and trust in WIPP's transportation program, especially for incidents in which some sort of emergency response is required.

The committee considers that given the potential interest in and visibility of WIPP shipments, the tracking system should provide reliable, real-time, and user-friendly access to information for the state users and other interested parties. In principle, this could be accomplished through upgrades to the current TRANSCOM system. However, rather than maintaining and upgrading a technically obsolete system, the committee believes that it would be more prudent for DOE to implement a less expensive, higher-quality system using a currently available commercial communications product (for a summary of transportation communication initiatives using information technology, see Allen [1998]). Careful screening of vendors is necessary to ensure that the desired system can perform to specification and be delivered on schedule and within budget.

Recent DOE efforts (Nelson, 1999b) are aimed at developing upgraded information technology capabilities ("TRANSCOM 2000") for the TRANSCOM system. Specifically, modem connections to access data of interest (e.g., the commercial bill of lading for a shipment) are to be replaced in the near future by internet postings. These plans for improved user interface and data distribution capabilities do not address other parts of the system, such as the speed with which data are acquired and proc-

essed prior to posting. These data acquisition and processing activities appear to introduce time delays that limit system performance; for example, position updates showing the locations of trucks along routes are delayed by several (up to seven) minutes (Nelson, 1999b). An as-yet-unspecified element of these planned upgrades is the extent to which future stakeholder participation will be solicited and used to provide sufficient feedback to ensure that the product ultimately developed addresses user concerns. Moreover, the timetable for off-the-shelf availability of TRANSCOM 2000 appears to the committee to be several years in the future, a problematic scenario for a WIPP shipping activity that is already underway.

One issue relevant to these planned information disclosures in TRANSCOM 2000 is the extent to which such information is needed or useful, by which parties, and to what ends. For example, the terrorist hazard and/or the potential for deliberate sabotage would presumably increase as this information is disseminated more broadly. If restricted access to certain information were important, security firewalls could be used to prevent internet information from being accessed outside of the TRANSCOM user community.

At present, the National TRU Program is one of many DOE users of the TRANSCOM system that is managed by another DOE program unit, the DOE transportation center in Albuquerque, New Mexico; other DOE transportation users include shippers of low-level waste and spent nuclear fuel. If the DOE transportation program that maintains TRANSCOM cannot provide sufficient improvements to fully implement the above recommendations, another approach would be for the National TRU Program to adapt a commercially available tracking system for use on WIPP shipments only. If the tracking system need only meet WIPP shipment requirements, the system specifications would likely be simpler, with a correspondingly greater likelihood that a commercially available product could be adapted for use. For example, WIPP shipments involve unclassified material, which may allow relief from the full suite of TRANSCOM system requirements that have been developed for all of DOE shipping needs.

DOE's Emergency Response Program

Finding: The responsibility for emergency response is divided between DOE and the states along WIPP shipment corridors. In the committee's view, a system to maintain up-to-date information on response capability would contribute significantly to the effectiveness of the transportation system. The WIPP emergency response program has not assessed sufficiently whether adequate and timely emergency response coverage for a transportation incident exists along the full extent of each WIPP route. No formal system presently exists to identify areas where coverage may be inadequate.

Recommendations: The committee recommends that DOE explore with states and other interested parties how to develop processes and tools for maintaining up-to-date spatial information on the location, capabilities, and contact information of responders, medical facilities, re-

covery equipment, regional response teams, and other resources that might be needed to respond to a WIPP transportation incident. This assessment should explore which organization(s) should develop and maintain the capability to generate and maintain such information. DOE should also determine where emergency response capability is currently lacking, identify organization(s) responsible for addressing these deficiencies, and take action to address them.

Rationale: To respond appropriately to any accident or other incident associated with a WIPP shipment, an emergency response system has been developed involving the DOE and state and local governments. Four levels of emergency response teams have been established. The first responders, typically the local police or local fire department, are to alert others. Their "911" call routes the incident to the attention of the second responders, the state emergency management agency, which then involves the state police and any state hazardous material (HAZMAT) or radiological response teams. The third responders are DOE Radiological Assistance Program teams that would be sent from major DOE sites (e.g., Idaho Engineering and Environmental Laboratory or the DOE Carlsbad Area Office) to conduct radiological emergency (medical) response. The fourth level of response is DOE remediation teams who perform measures such as righting a truck and any necessary site cleanup and restoration activities (DOE, 1998a).

Because of the required integrity of the TRUPACT-II shipping container, which is tested and certified to conform to the USNRC's 10 CFR 71 regulatory requirements, the containment offered by this container normally cannot be breached in an accident scenario. Therefore, emergency response procedures in these four levels of response normally would preclude any consideration of releases of materials from the TRUPACT-II. Under normal conditions, the emergency response procedures would still be needed for traffic management and other necessary operations in accident-related situations.

DOE's emergency response program relies heavily on WIPP corridor states to conduct emergency responder training and develop response plans in the event of a transportation incident. DOE also maintains its own specialized response capabilities that can be deployed on an as-needed basis. Although this approach offers certain advantages in terms of state and local involvement, system-level integration is a significant concern.

Maintaining an effective emergency response program necessitates that, if an incident should occur anywhere along a WIPP route, qualified responders can reach the scene in a timely fashion. Emergency preparedness is a formidable challenge given the thousands of miles of highway that comprise WIPP routes.

While WIPP corridor states are coordinating with DOE to ensure the safe transport of WIPP shipments[18] (DOE, 1995, 1999b; Klaus, 1999; Ross, 1999; Wentz, 1999), the public may view this responsibility as ulti-

[18]These activities have included training drills that have been conducted over the past several years to simulate real transportation procedures and accident scenarios.

mately resting with DOE as the system manager. The public might well expect qualified emergency response coverage along the entire length of each WIPP route, and in the committee's view, DOE could be heavily criticized if an event occurs that demonstrates weaknesses in the emergency response program, regardless of whether serious consequences are involved. Hence, although the recommendations in this section are not legal requirements, these assessments of the emergency response capabilities are, in the committee's view, important for providing a well-orchestrated transportation system.

The system-level integration necessary to ensure adequate emergency response would have to manage the jurisdictional boundaries between the various responsible government agencies. For example, under the federal Occupational Safety and Health Act (specifically, 29 CFR 1910.120), an employer is responsible for providing training; consequently, the state has the responsibility to determine the extent and adequacy of training (i.e., who is trained and in what capabilities) for first- and second-level responders. States have, to date, offered free WIPP-related training opportunities. No "quality assurance" program yet exists to evaluate periodically and systematically the extent of training and response capabilities within states. Moreover, the database lists trained personnel by state only, rather than by local region (e.g., county). As required by the Land Withdrawal Act, DOE provides the states with WIPP-specific hazard information, but DOE does not furnish protective, detection, monitoring, or communication equipment to states.

These and other demarcations of responsibilities should be managed to ensure that prompt and effective response capability for any transportation incident exists anywhere along a WIPP route. Although the training and response time associated with the first and second responders are not under DOE's direct control, a system to assess the extent and adequacy of this response coverage would be useful for DOE to properly prepare for and manage WIPP transportation incidents.

Committee Perspective on National TRU Program Requirements

A reasonable goal for the National TRU Program is to send DOE TRU waste to WIPP at a minimum risk (from all sources of risk, including radiological exposure and highway accidents) and cost. The current system for managing TRU wastes does not achieve this goal. The current transportation system cannot be used to ship a large fraction of the TRU waste volume without significant repackaging (Connolly and Kosiewicz, 1997; DOE, 1999b; Mroz et al., 1997). For the waste inventory that does qualify for shipment in this system, risk and cost considerations have not been optimized.

The terms and activities selected by DOE Carlsbad Area Office for submission to its regulatory authorities to satisfy applicable regulations and other concerns do not produce an optimum balance between risk and cost, in the spirit of ALARA. **The committee recommends that waste management procedures be reviewed and revised, with reduction of risk and cost as the guiding principles.**

As experience is gained in the WIPP shipping program, empirical data could be gathered to improve upon the initial estimates of risk and cost that are associated with each operation. The effort to reduce risks and costs necessarily would include some consideration of uncertainty, the procedures needed to adequately bound this uncertainty, and an assessment of which TRU waste program elements are the most important to control.

For example, the current National TRU Program has many procedures to control certain program elements. Over time, the most effective of such controls could be identified and retained. The reduction of risks and costs is possible in a management approach that takes into consideration public preferences for certain restrictions and implements procedures to minimize relevant uncertainties. As empirical data and experience are gathered, estimates of risks and costs of various components of the TRU waste operations can be refined. Such risk and cost estimates are useful to probe the elements of the waste management system that need to be controlled most restrictively, whether to meet legal or technical safety restrictions or to address public preferences for how radioactive waste is to be managed and transported.

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Appendix A

Background Information

The material in this appendix provides background information on the long-term performance of the Waste Isolation Pilot Plant (WIPP) as well as waste characterization and transportation activities associated with the National TRU Program.

Assessment of Long-Term Performance

The ability of WIPP to isolate radioactive waste from the accessible environment has been studied and modeled in a performance assessment calculation. The performance assessment organizes information relevant to long-term (i.e., over a 10,000-year period) repository behavior by assessing the probability and consequence of major scenarios by which radionuclides can be released to the environment surrounding the WIPP site. Important scenarios include those due to human activities, whether deliberate or unintentional, that might occur near the WIPP site and potentially compromise the integrity of the repository. For example, drilling for hydrocarbon resources in formations underlying WIPP is currently practiced in the Delaware Basin on land surrounding the WIPP site; therefore, stylized "human intrusion" scenarios in which future boreholes are drilled through WIPP have been analyzed in the performance assessment model.

Using this performance assessment, the U.S. Department of Energy (DOE) has modeled the long-term performance of the WIPP repository to meet regulatory requirements. As specified by the 1992 Land Withdrawal Act (P.L. 102-579) passed by the U.S. Congress, the U.S. Environmental Protection Agency (EPA) is the external regulatory authority for WIPP, using as a regulatory standard the rule 40 CFR 191.[1] The performance assessment model formed the basis of the 1996 DOE application to the EPA to obtain a certificate of compliance with the 40 CFR 191 standard to open and operate WIPP. The EPA granted this certificate in 1998, and EPA oversight continues in periodic (i.e., every five years)

[1]For compliance with the standard of 40 CFR 191, the EPA issued rule 40 CFR 194 in 1996 to provide a regulatory interpretation of how these requirements would apply to WIPP.

recertifications. Changing some of the repository features (e.g., the design of the engineered seals to close underground rooms once they are filled with waste or the design of the seals to close the vertical shafts to the surface) would require regulatory approval because of their importance to the model of long-term performance.

DOE Management of TRU Waste

Transuranic (TRU) wastes are stored and managed at several DOE sites nationwide. To dispose of these wastes at WIPP, they must be retrieved from storage, characterized, repackaged (if necessary), and transported to WIPP, where they are unloaded from shipping containers and sent underground for emplacement in the disposal rooms.

These activities are conducted under the auspices of the National TRU Program administered by the DOE Carlsbad Area Office. DOE sites sending waste to WIPP must meet the waste characterization and transportation specifications that are contained in the WIPP waste acceptance criteria. The specifications on characterization and transportation operations are designed to meet all applicable regulations that have been promulgated by the EPA (chiefly through the Resource Conservation and Recovery Act, or RCRA), the U.S. Nuclear Regulatory Commission (USNRC), and the U.S. Department of Transportation (DOT). The waste characterization activities and the transportation system are described in more detail below.

Waste Characterization Activities

The characterization program described here has been developed for contact-handled[2] TRU waste and applied to date on non-mixed waste.[3] The methods, equipment, procedures, determination of uncertainty, and other protocols used at DOE sites to perform these characterizations are approved by both the DOE Carlsbad Area Office and the EPA. The major procedures are as described in the following sections:

Determination of the Origin and Composition of the Waste by Acceptable Knowledge. Acceptable knowledge of the origin and composition of the waste must be available in documentation to prove that the waste is of defense origin (by the terms of the Land Withdrawal Act, only defense-related TRU waste may legally be sent to WIPP) and to provide

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[2]Contact-handled waste is that for which the maximum radiation dose rate at the surface of the waste container is less than 200 mrem per hour. Essentially no shielding other than the waste container is needed. Much of the DOE TRU waste has radioactivity due primarily to alpha-emitting actinides. Because alpha particles are relatively easy to shield, such waste would have a low surface dose rate and therefore would be classified as contact-handled waste.

[3]Mixed waste is waste with radioactive constituents regulated under the Atomic Energy Act mixed with hazardous chemical materials regulated under RCRA. Non-mixed radioactive waste is waste that can be shown not to contain RCRA-regulated materials.

characterization information on the waste constituents. The DOE Carlsbad Area Office and EPA use the acceptable knowledge documentation to certify each "waste stream" (i.e., waste-generating process), and TRU waste sent to WIPP must come from a certified waste stream.

Sampling and Analysis of Homogeneous Waste for RCRA Constituents. Most of the TRU waste is heterogeneous in nature and requires no further characterization beyond acceptable knowledge to satisfy the regulatory requirements of RCRA. For homogeneous waste, a fraction of the waste containers (e.g., 55-gallon drums or standard waste boxes) are cored to extract representative samples that are analyzed for constituents (e.g., volatile and semi-volatile organic compounds, toxic metals, and other hazardous chemicals) regulated by RCRA. Both the acceptable knowledge procedure (for heterogeneous waste) and the sampling and analysis procedure (for homogeneous waste) were proposed by DOE for the terms of operation that would be specified in its RCRA Part B permit. These terms have been accepted by New Mexico, which has authority delegated by the EPA to regulate RCRA materials and mixed waste and which issued the RCRA Part B permit in October 1999.

Real-Time Radiography. A real-time radiography procedure using x-rays is performed on all waste containers to look for items such as pressurized cans or free-standing liquids that are prohibited from being transported under DOT regulations. If any of these items are present in a waste container, its contents are repackaged, at which time the prohibited materials are removed. Another purpose of the radiography examination is to confirm the acceptable knowledge characterization information.

Visual Examination. A visual examination is performed on a fraction of the waste containers, by spilling the waste contents into a glovebox, to verify the acceptable knowledge and real-time radiography information. The value of this fraction was proposed by DOE to be two percent of the initial population of containers of each waste stream, and if these evaluations resulted in few miscertifications, then the percentage of subsequent waste containers to undergo visual examination would be reduced. In October 1999, New Mexico in its RCRA Part B permit stipulated the initial fraction of containers to undergo visual examination to be 11 percent.

Radioassay and Determination of Fissile Isotope Content. The number of curies of each transuranic isotope is determined by radioassay (e.g., gamma scans) to a specified precision and accuracy. The fissile isotope content is assessed using methods such as passive-active neutron systems. This information is used to ensure criticality safety, a USNRC requirement, which imposes a restriction on the amount (several hundred grams) of each fissile species per container. This restriction is less stringent than the amount derived from the gas generation model, discussed below.

Headspace Gas Sampling. Headspace gas sampling is carried out on all waste containers for flammable gases (specifically, volatile organic compounds, hydrogen, and methane). This procedure has been proposed

as a means of checking on conformity with the DOT regulations (e.g., 40 CFR 173 and 40 CFR 177) and USNRC regulations (e.g., 10 CFR 71) that address the transport of flammable and/or gas-generating substances with radioactive materials (Mewhinney, 1998b). These regulations include the following statements:

- 49 CFR 173.21(g): "Packages which give off a flammable gas or vapor, released from a material not otherwise subject to this subchapter, likely to create a flammable mixture with air in a transport vehicle" are forbidden.
- 49 CFR 173.21(h): "Packages containing materials which will detonate in a fire" are forbidden.
- 49 CFR 173.24(b)(3): "There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, significantly reduce the effectiveness of the packaging."
- 49 CFR 177.848 specifies that flammable gases and radioactive materials "may not be loaded, transported, or stored together in the same transport vehicle or storage facility during the course of transportation unless separated in a manner that, in the event of leakage from packages under conditions normally incident to transportation, commingling of hazardous materials would not occur."
- 10 CFR 71.43(d): "A package must be made of materials and construction that assure that there will be no significant chemical, galvanic, or other reaction among the packaging components, among package contents, or between the packaging components and the package contents, including possible reaction resulting from in leakage of water, to the maximum credible extent. Account must be taken of the behavior of materials under irradiation."

DOE has proposed the headspace gas sampling procedure in its application to the USNRC for a licensing certificate on the transportation package (named the TRansUranic PACkage Transporter, or TRUPACT-II) that is loaded with waste containers for transport by truck to WIPP.

Repackaging of Waste to Meet Wattage Limits Imposed by a Radiolytic Gas Generation Model. Gas generation can occur during the transport of a waste container to WIPP. The radiolytic generation of hydrogen gas in TRU waste comes from the co-disposal of organic materials (containing hydrogen) with alpha-emitting radionuclides, which irradiate the organic matter to produce H^+ ions that combine to form H_2 molecules. The current gas generation model is based on assumptions about the configuration of organic materials and radionuclides. It relates the concentration of hydrogen gas in any headspace to the alpha activity (i.e., activity from alpha-emitting radionuclides) within each waste container. More than one gaseous headspace can exist in a waste container, primarily because TRU waste, when generated and disposed in DOE facilities, was contained within layers of confinement provided by plastic bags that may still be intact and thereby inhibit the flow of hydrogen.

By placing a 5 percent (mole fraction) limit on the maximum H_2 concentration within any headspace, this gas generation model calculates an upper limit, commonly expressed as a maximum thermal wattage, on the alpha activity allowed for the entire waste container. These wattage limits are a function of the waste materials and the number of layers of confinement provided by plastic bags. Because of its conservatism, the value of 5 percent H_2 (as a mole fraction) in air as a "flammability limit" can be used in any USNRC license application for a transportation package without the need for further safety analysis.

For example, for a 55-gallon drum containing a plastic liner and heterogeneous debris with plutonium inside three layers of sealed plastic bags, the wattage limit is approximately 0.028 W (DOE, 1996b, p. 5-6e), which corresponds to a limit of 14 g (0.89 Ci) of plutonium-239 or 0.049 g (0.84 Ci) of plutonium-238. Waste containers containing more wattage than the maximum value allowed by the model have their waste contents repackaged to distribute the TRU waste into configurations that will meet these wattage limits. This is accomplished by spilling these contents into shielded gloveboxes and dividing the waste into several new containers, each filled with a fraction of the contents of the original waste container. At Los Alamos National Laboratory in 1998-1999, gas generation restrictions resulted in the repackaging of 36 drums of plutonium-238 waste from the waste stream "TA-55-43" into approximately 120 drums that were placed inside standard waste boxes.[4]

The output of the characterization program is a set of characterization data for each waste container. If the characterization information is within acceptable limits as determined by the waste acceptance criteria and quality assurance program plan (or waste analysis plan) specifications, the waste container is certified and approved for shipment to WIPP.

Truck Transportation to WIPP

At the DOE sites containing TRU waste, the certified TRU waste containers are loaded inside TRUPACT-II shipping containers that are then sealed with a vacuum-tight seal. The TRUPACT-II is classified and regulated as a "Type B" package for fissile materials.[5] To ensure that the waste contents are safely contained during normal shipment conditions and accident scenarios, this transportation package must meet design features such as double containment (i.e., it must have an inner and outer container) and a vacuum seal. Within the inner container, two standard waste boxes, fourteen 55-gallon drums, or one standard waste box and seven 55-gallon drums can be placed. These waste containers are loaded into the TRUPACT-II using an overhead crane in a bay of a building that a truck can drive into to avoid the need to unfasten the TRUPACT-II from the trailer.

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[4]A 55-gallon drum has a volume of approximately 0.2 m^3, whereas a standard waste box is a 1.9m^3 container that can hold three 55-gallon drums.

[5]This designation is a regulatory term to designate packages used to transport plutonium isotopes, which are contained in TRU waste.

The trucks travel to WIPP on approved highway routes during approved times and maintain communication with a DOE control center. In addition to a cellular telephone and a citizens band radio, each truck contains a satellite transponder that enables it to be tracked en route using DOE's satellite-based telecommunications system, the TRANSportation Tracking and COMmunication (TRANSCOM) System. The TRUPACT-IIs are inspected at the WIPP site and their contents (waste-filled drums or boxes) are unloaded and delivered to an underground elevator for emplacement into rooms excavated in the subsurface salt bed.

Appendix B

Joint USNRC and EPA Guidance on Mixed Waste

A joint U.S. Nuclear Regulatory Commission (USNRC) and U.S. Environmental Protection Agency (EPA) document (62 FR 62079, 1997) provides regulatory guidance outlining the testing requirements for mixed radioactive and hazardous waste. In this dual agency guidance document, the EPA and USNRC position is that a combination of common sense, modified sampling procedures, and cooperation between state and federal regulatory agencies will minimize any hazards associated with sampling and testing mixed waste.

Waste generators may determine whether their waste is a Resource Conservation and Recovery Act (RCRA) hazardous waste based on knowledge of the materials or chemical processes that were used. That is, RCRA regulations do not require testing of the waste.

Therefore, where sufficient knowledge of materials or of the process exists, the generator need not test the waste to determine that it possesses a hazardous characteristic, which would necessitate that RCRA be applied (although generators and subsequent handlers would be in violation of RCRA if they managed hazardous waste erroneously classified as nonhazardous outside the RCRA hazardous waste system). For this reason, facilities wishing to minimize testing often assume that a questionable waste is hazardous and handle it accordingly.

Flexibility exists in the hazardous waste regulations for generators; operators of treatment, storage, and disposal facilities; and mixed waste permit writers to tailor mixed waste sampling and analysis programs to address radiation hazards. For example, upon the request of a generator, a person preparing a RCRA permit for such a facility has the flexibility to minimize the frequency of mixed waste testing by specifying a low testing frequency in a facility's waste analysis plan. The EPA position, as stated in 55 FR 22669 (1990), is that the frequency of testing is best determined on a case-by-case basis by the permit writer.

The joint USNRC-EPA agency guidance document (62 FR 62079, 1997) appears to the committee to provide appropriate guidelines for implementation and integration of RCRA requirements for mixed TRU waste. Implementation of this regulatory guidance could significantly reduce the testing protocols and associated radiation exposure of personnel. At present, the procedures specified in the waste acceptance criteria

and quality assurance program plan documents and in the RCRA Part B permit for the testing of mixed waste seem at odds with the ALARA (as low as reasonably achievable) principle.

Appendix C

Biographical Sketches of Committee Members

B. John Garrick, *Chair*, independent consultant, is a co-founder of PLG, Inc., an international engineering, applied science, and management consulting firm in Newport Beach, California. He received his B.S. degree from Brigham Young University and his M.S. and Ph.D. degrees in engineering and applied science from the University of California, Los Angeles. His professional interests involve risk assessment in applications in fields such as nuclear energy, space, and defense, and in the chemical, petroleum, and transportation industries. He has received numerous awards, including the Society for Risk Analysis Distinguished Achievement Award. He was appointed to the U. S. Nuclear Regulatory Commission's Advisory Committee on Nuclear Waste in 1994, for which he is now Chairman. Dr. Garrick was elected to the National Academy of Engineering in 1993. He has been a member of the Committee on the Waste Isolation Pilot Plant since 1989.

Mark Abkowitz, professor of civil engineering at Vanderbilt University and director of the Center for Environmental Management Studies, has many years of experience in hazardous materials transport. He has published widely on transportation issues such as the risks of transporting high-level radioactive waste. He is a member and former chairman of the NRC Transportation Research Board standing committee on hazardous materials transport.

Alfred W. Grella, independent nuclear and hazardous materials transportation consultant, retired in 1990 from a career in U.S. government service, first at the Department of Transportation and later at the U.S. Nuclear Regulatory Commission. His distinguished career spans 40 years as a professional in health physics, health protection, transportation, inspection and enforcement, training, and related regulatory activities. Mr. Grella received a Bachelor's degree in chemistry from the University of Connecticut and completed the one-year management program at the National Defense University Industrial College of the Armed Forces. He has authored over 30 published papers. He is a member of the American Nuclear Society and a Fellow of the Health Physics Society. Mr. Grella received the M. Sacid (Sarge) Ozker Award in 1996 for distinguished serv-

ice and eminent achievement in the field of radioactive waste management.

Michael Hardy, president of Agapito Associates, Inc., has experience in numerical modeling and field experimentation in practical, engineering-oriented studies to gather characterization data and to evaluate the merits of design features of proposed high-level waste repositories. Dr. Hardy is a member of the Society of Mining, Metallurgical and Exploration Engineers, Inc., and the American Society of Civil Engineers (ASCE). He is Chairman of the Underground Technical Research Council, a joint ASCE/American Institute of Mining, Metallurgical, and Petroleum Engineers Committee.

Stanley Kaplan, principal of Kaplan & Associates, Inc., is one of the early practitioners of the discipline now known as Quantitative Risk Assessment and a major contributor to its theory, language, philosophy and methodology. Dr. Kaplan is a Fellow of the Society for Risk Analysis and the author of a number of the seminal papers in this field. He is one of the first contributors to the Russian science TRIZ, the Theory of the Solution of Inventive Problems, and currently consults and teaches in this area. He is a founder and board chairman of Bayesian Systems, Inc., a Washington-based company developing diagnostic, decision, simulation, and business management software. Dr. Kaplan is the recipient of several awards and honors, including the Society for Risk Analysis Distinguished Achievement Award in 1996. Dr. Kaplan was elected to the National Academy of Engineering in 1999.

Howard M. 'Skip' Kingston is professor of chemistry in the Department of Chemistry and Biochemistry and in the Center for Environmental Research and Education. Also at Duquesne University, he is director of the Center for Microwave and Analytical Chemistry. His research interests include the development, automation, and standard encapsulation and transfer of analytical analysis methods. For the past several years, he has been actively involved in advancing the area of microwave sample preparation through basic research and the development of procedures that have been adopted by the EPA as standard methods. From 1976 to 1991 he was a supervisory research chemist in the Inorganic Analytical Research Division of the National Institute of Standards and Technology (NIST), where he conceived and managed the Consortium on Automated Analytical Laboratory Systems dedicated to developing automated analytical capability for industry. He has received numerous awards for his pioneering work in several areas, including R&D 100 Awards in 1996 and 1998, the IR 100 Award in 1987, the 1988 "Pioneer in Laboratory Robotics" award, the 1990 NIST Applied Research Award, the Department of Commerce Bronze Medal in 1990, the Award of Merit from the Federal Laboratory Consortium in 1991, and the EPA RCRA Service to Others Award in 1998. He has co-edited and co-authored the American Chemical Society professional reference texts *Introduction to Microwave Sample Preparation: Theory and Practice* (1988) and *Microwave Enhanced Chemistry: Fundamentals, Sample Preparation, and Applications* (1997).

He holds multiple patents in the field of speciation, microwave chemistry, and chelation chromatography.

W. John Lee, Peterson Chair and professor of petroleum engineering at Texas A&M University and formerly executive vice-president of technology at S. A. Holditch & Associates, Inc., has expertise in petroleum reservoir imaging, flow tests in low-permeability formations, and enhanced recovery practices. Professor Lee was elected to the National Academy of Engineering in 1993.

Milton Levenson, independent consultant, is a chemical engineer with over 50 years of experience in nuclear energy and related fields. His technical experience includes work in nuclear safety, fuel cycle, water reactor technology, advanced reactor technology, remote control technology, and sodium reactor technology. His professional experience includes research and operations positions at Oak Ridge National Laboratory, Argonne National Laboratory, the Electric Power Research Institute, and Bechtel. Mr. Levenson is the past president of the American Nuclear Society; a fellow of the American Nuclear Society and the American Institute of Chemical Engineers; and the recipient of the American Institute of Chemical Engineers' Robert E. Wilson Award. He is the author of over 150 publications and presentations and holds three U.S. patents. He received his B.Ch.E. from the University of Minnesota. He was elected to the National Academy of Engineering in 1976.

Werner F. Lutze, professor of chemical and nuclear engineering at the University of New Mexico and director of the UNM Center for Radioactive Waste Management (CeRaM), has over 25 years of research experience in materials science and geochemical issues relevant to the management of radioactive wastes, including selective mineral ion-exchange processes, repository near-field chemistry, waste form development, and trace analyses. He has published widely on weapons plutonium immobilization, waste disposal, and the chemistry of nuclear materials. Professor Lutze is a member of several professional organizations, including the Materials Research Society, the German Nuclear Society, and Sigma Xi.

Kimberly Ogden, associate professor of chemical and environmental engineering at the University of Arizona, has conducted research with Los Alamos National Laboratory collaborators to design treatment methods for remediating hazardous waste sites containing both toxic metals and organics, including plutonium-cellulose mixtures. She is also engaged in collaborations with ECO Compliance Inc. in preparing proposals and reports for the remediation of hazardous waste sites. Professor Ogden has authored or co-authored several book chapters, papers, and presentations in environmental science and technology. She is a member of the American Institute of Chemical Engineers, the American Association for the Advancement of Science, and the American Chemical Society.

Martha Scott, associate professor of oceanography at Texas A&M University, is a researcher in marine radiochemistry and geochemistry. Her

present research involves radionuclide distribution in the Russian Arctic. Her work has dealt with the interaction between oceans and rivers, transport of materials in the marine environment, and chemistry of manganese nodules. The behavior of plutonium isotopes in rivers, estuaries, and marine sediments has been one of her longstanding research interests. She served for two years as an associate program director for chemical oceanography at the National Science Foundation (1992-1993). She received the Ph.D. degree from Rice University and was a National Science Foundation post doctoral fellow at Yale University.

John M. Sharp, Chevron Centennial Professor of Geology at The University of Texas at Austin, leads an active research program in hydrology. Professor Sharp has authored and co-authored over 200 journal articles, books, reports, and presentations. He is a fellow of the Geological Society of America and recipient of its O.E. Meinzer award (1979) and the American Institute of Hydrology's C.V. Theis Award (1996). Dr. Sharp is the current editor of *Environmental and Engineering Geoscience*. He received his B. Geological E. with Distinction from the University of Minnesota and his M.S. and Ph.D. degrees in Geology from the University of Illinois.

Paul G. Shewmon, emeritus professor of materials science and engineering at the Ohio State University, received a B.S. degree in metallurgical engineering from the University of Illinois and M.S. and Ph.D. degrees, also in metallurgical engineering, from the Carnegie Institute of Technology. He recently retired as Humbolt Senior Scientist at the Max Planck Institute Metallforschung in Stuttgart. He has received the ASM deMille Campbell Lecture and Award and the TMS Institute of Metals Lecture & Mehl Medal. He was elected to the National Academy of Engineering in 1979.

James Watson, Jr., professor of environmental sciences and engineering and the Director of the Air, Radiation, and Industrial Hygiene Program at the University of North Carolina at Chapel Hill, holds an M.S. degree in physics from North Carolina State University and a Ph.D in environmental sciences and engineering from the University of North Carolina at Chapel Hill. Professor Watson is accomplished in the fields of environmental radioactivity and radioactive waste management. He has received the Underwood and McGavran Awards for excellence in teaching and the Greenberg Alumni Endowment Award for excellence in teaching, research, and service. He is a past president of the Health Physics Society and a past chairman of the Radiological Health Section of the American Public Health Association. He has served on the Environmental Protection Agency's Radiation Advisory Committee and the executive committee of the agency's Science Advisory Board. He is a past chairman of the North Carolina Radiation Protection Commission and currently chairs the commission's Committee on Low-Level Radioactive Waste Management.

Ching H. Yew, an independent consultant and emeritus professor from The University of Texas at Austin, has specialized in the study of hydraulic fracturing and borehole stability. Dr. Yew is a fellow of the America Society of Mechanical Engineers and a member of the Society of Petroleum

Engineers. Dr. Yew has authored a text and published several articles concerning hydraulic fracturing and borehole stability. The computer code developed by him has been adopted for field use by many oil and gas industries.

Appendix D

Acronyms

ALARA	as low as reasonably achievable
ATMX	Atchison Topeka Munitions private railcar
CFR	Code of the Federal Regulations
CEMRC	Carlsbad Environmental Monitoring Research Center
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
NORM	naturally occurring radioactive material
NRC	National Research Council
RCRA	Resource Conservation and Recovery Act
TRANSCOM	TRANSportation Tracking and COMmunication system
TRU	transuranic
TRUPACT	TRansUranic PACkage Transporter
USNRC	U.S. Nuclear Regulatory Commission
WIPP	Waste Isolation Pilot Plant

MAXIMUM VOC EMISSION RATES FROM RH CANISTERS

1.0 INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is operating under a Resource Conservation and Recovery Act (RCRA) Hazardous Waste Facility Permit (Permit) that contains limitations on allowable emissions from contact-handled (CH) transuranic (TRU) waste. The environmental performance standard imposed on the WIPP consists of controlling volatile organic compound (VOC) emissions to ensure the public and facility worker safety. The environmental performance standard for VOC emissions is based on the container headspace gas concentration, filter type, number of containers emitting, and the mine ventilation rate. All of these factors were considered in the requirements specified in the Permit.

TRU wastes that have a measured radiation dose rate greater than 200 mrem/hr are classified as remote-handled (RH) TRU wastes. These RH wastes contain larger quantities of radionuclides that emit beta and gamma as well as alpha radiation. In fact, the main difference between the RH-TRU waste and CH-TRU waste is the presence of larger amounts of fission and activation products (e.g., Cesium-137, Strontium-90, Barium-137m, and Cobalt-60) in RH-TRU waste. These fission and activation products emit penetrating X- and gamma radiation, and have relatively short half-lives (typically 30 years or less).

The WIPP Land Withdrawal Act (LWA) and the Consultation and Cooperation (C&C) Agreement with the State of New Mexico permit disposal volumes of 168,500 cubic meters (5,950,000 cubic feet) for CH-TRU waste and 7,080 cubic meters (250,000 cubic feet) for RH-TRU waste. Section 7(a) of the LWA limits the surface dose rate from RH waste to 1,000 rems per hour, and no more than 5% of the volume of RH waste can exceed 100 rems per hour. The DOE plans to process certain RH-TRU wastes to immobilize radionuclides. The final treated RH-TRU waste inventory will contain primarily heterogenous waste, solidified inorganics, and metals.

TRU wastes will be transported to the WIPP by truck from the DOE sites. Upon arrival at the WIPP, each RH-TRU shipment will be inspected and removed from the transport vehicles and positioned for waste transfer. The canister will then be removed from the shipping cask, loaded into a heavily shielded Facility Cask, and lowered underground through the Waste Shaft for emplacement. The Facility Cask will be transported to the disposal location and the canister will be emplaced with the Facility Cask held in position to provide adequate shielding at all times.

The waste disposal area within WIPP consists of eight panels, each containing seven rooms between access drifts. The RH-TRU wastes will be emplaced in a manner different from that for the CH-TRU wastes because of packaging, shielding, and loading requirements; operational equipment; and structural considerations. The current disposal configuration of the CH-TRU inventory includes emplacement of the waste packages in disposal rooms that measure 33 ft wide, 13 ft high, and 300 ft long (DOE 1991). The current configuration for RH-TRU disposal includes emplacement into the walls in horizontal boreholes. These boreholes will be drilled 4 feet from the floor on 8-foot centers (DOE 1991). There will be approximately 7,955 RH-TRU waste boreholes. A shield plug capping each borehole after emplacement of the RH-TRU canister in the room wall will provide the necessary shielding required for worker safety. Appendix A of the *Remote-Handled Transuranic Waste Study* (DOE 1995) includes a description of the RH-TRU shield plug currently planned for implementation.

2.0 METHODOLOGY

The processes that will contribute to VOC emissions from the RH canisters are the same as those evaluated for CH waste. Therefore, the calculations used to evaluate VOC emissions from emplaced RH canisters will use the same equations as those used to evaluate VOC emissions in the original permit

application. However, because RH canisters are located in the walls of the rooms behind shield plugs, the actual methodology is the same as that used for waste in a closed room.

RH canisters will not release VOCs into the underground ventilation the same way as CH waste containers in an active room. The RH waste is placed in a dead-end borehole that is capped by a low-permeability shield plug. Because the RH canister is in a dead-end borehole with a shield plug, mine ventilation will not pass over the canister as it does for containers on the floor of an active room. This lack of ventilation causes an emplaced RH canister with a shield plug to a release VOCs similarly to a closed room.

A closed room uses ventilation barriers to restrict the flow of mine ventilation through a filled room. The shield plugs on each borehole containing an RH canister will function similarly to the ventilation barriers. The shield plugs will restrict the movement of mine ventilation and diffusion of VOCs from the borehole just as the ventilation barriers will restrict the movement of mine ventilation and diffusion from a filled room.

The permit application demonstrated that gas pressurization is the primary mechanism that might cause VOCs to migrate out of a closed room. Based on this analysis, the WIPP's Hazardous Waste Facility Permit establishes VOC limits for operations. Therefore, the analysis of the emissions from an emplaced canister in a shield plug capped dead-end borehole results in the maximum credible gas pressurization rate per borehole and the per room potential maximum VOC emission rates from the RH-TRU waste following the existing closed room methodology.

As a bounding conservative assumption, all canister headspaces are assumed to have saturated VOC concentrations at the temperature of WIPP. Pressurization within a borehole will be caused by a combination of gas generation and reduction of the borehole due to creep closure of the salt (DOE 1996a), which might result in VOC emissions from the canister into the room.

2.1 VOC Concentrations in the RH Canister Headspace

The VOC concentrations in the canister headspace are assumed to be equal to the saturated vapor pressure concentrations. This is the maximum concentration in the gas phase that can occur at the temperature in the underground at the WIPP. In addition, physical interactions of the VOCs within the liquid phase are ignored because these would reduce the concentrations in the gas phase. The saturated vapor concentrations of the VOCs are calculated from the vapor pressures at the temperature of WIPP (i.e, at 303 K) (DOE 1996b).

The vapor pressures of the VOCs at 303 K were calculated using Equation (1) of Appendix A of Reid et al. (1987) as:

$$\ln(Pvp / Pc) = (1-x)^{-1}[(VP\ A)x + (VP\ B)x^{1.5} + (VP\ C)x^{3} + (VP\ D)x^{6}]$$

where,

$$x = 1 - T / Tc$$

Pvp = VOC vapor pressure at 303 K, (bars)
Pc = VOC critical pressure, (bars)
Tc = VOC critical temperature, (K)
T = Temperature of WIPP disposal room (303 K)

The critical pressures and temperatures of the VOCs as well as the coefficients VP A, VP B, VP C, VP D required for Equation (1) are listed in Table 1.

Table 1. VOC Properties

Compound	Properties of Gases & Liquids Appendix A No.	MW (g/mol)	Tc (K)	Pc (bar)	VP A	VP B	VP C	VP D	x (Equation (1) for VP)	ln(Pvp/Pc) from Eq. 1 for VP	Pvp (bar)	Pvp (atm)	VOC Mole Fraction
Carcinogens													
Carbon Tetrachloride	94	153.84	556.4	45.6	-7.07139	1.71497	-2.8993	-2.49466	0.4554277	-5.4897228	0.1883	0.1858	0.1858
Chloroform	103	119.39	536.4	53.7	-6.95546	1.16625	-2.1397	-3.44421	0.435123	-5.1186177	0.3214	0.3172	0.3172
1,1-Dichloroethene	None	96.95	513	48.1							0.9533	0.9408	0.9408
1,2-Dichloroethane	158	98.97	566	53.7	-7.36864	1.76727	-3.34295	-1.4353	0.4646643	-6.0037215	0.1326	0.1309	0.1309
Methylene Chloride	107	84.94	510	63	-7.35739	2.17546	-4.07038	3.50701	0.4058824	-4.511202	0.6921	0.6830	0.6830
1,1,2,2-Tetrachloroethane	143	167.86	661.2	58.4	-7.98542	2.49931	-4.07076	-0.6918	0.5417423	-8.7160059	0.0096	0.0094	0.0094
1,1,1-Trichloroethane	149	133.42	545	43	-7.31317	2.04642	-3.77747	-0.45475	0.4440367	-5.3528837	0.2036	0.2009	0.2009
Noncarcinogens													
Chlorobenzene	340	112.56	632.4	45.2	-7.587	2.26551	-4.09418	0.17038	0.5208729	-7.6709981	0.0211	0.0208	0.0208
Toluene	400	92.13	591.8	41	-7.28607	1.38091	-2.83433	-2.79168	0.4880027	-6.7421505	0.0484	0.0478	0.0478

There are no vapor pressure coefficients available for 1,1-dichloroethene. The vapor pressure of this VOC was interpolated from a vapor pressure table for this compound from the *Handbook of Chemistry and Physics* (CRC 1978). The relevant values are listed in Table 2. In interpolating the vapor pressure at 303 K, the relationship that the logarithm of the vapor pressure vapor pressure is inversely proportional to the temperature (Treybal 1980) was used.

Table 2. 1,1-Dichloroethene Vapor Pressures

Temperature (°C)	Temperature (K)	Vapor Pressure (Pvp) (mmHg)
14.8	287.8	400
31.7	304.7	760

$$\frac{1/287.8 - 1/303}{1/287.8 - 1/304.7} = \frac{\log 400 - \log Pvp(303)}{\log 400 - \log 760}$$

Solving for the vapor pressure of 1,1-dichloroethene at 303 K, log Pvp(303) gives

log Pvp(303) = 6.572

Pvp(303) = 715 mm Hg = 715 mHg/(760 mmHg/atm) = 0.9408 atm

The methodology used to calculate the vapor pressure concentration for each of the VOCs in the gas phase ignores the effects of the other VOCs present. This is another conservative approach because, in reality, interference from other VOCs will cause the actual concentrations to be less than the saturated vapor pressure concentrations in air. In addition, no credit is taken for the diffusion of the filters or any source reduction resulting in a steady state concentration being assumed behind the shield plug. Therefore, the gas being emitted into the room is conservatively assumed to constantly be at the saturated vapor pressure concentrations.

2.2 Number of RH Canisters In a Room

The first step in establishing the total rate of gas pressurization from RH canisters is to establish the number of RH canisters per room. Based on Figure 4.2-7 of the WIPP RH PSAR (DOE 1999), a typical panel will have 730 RH boreholes. Room 1 of a panel will have the most boreholes i.e. 120 RH. As a conservative assumption, the calculations will use this maximum number.

2.3 Gas Generation Mechanisms

Based on existing studies, potential gas generation mechanisms include:

- Microbial degradation of plastics
- Anoxic corrosion of metal
- Radiolysis of waste materials
- Gas displacement due to creep closure of the salt borehole

The potential for and magnitude of each mechanism on VOC emissions from the RH-TRU waste canisters are discussed below.

2.3.1 Microbial Gas Generation

Microbial gas generation due to degradation of plastics produces 0 to 0.04 mole/kg cellulosics/yr under humid conditions. (DOE 1996b). The total mass of equivalent cellulosics is given by Equation (6) of *Gas Generation Information* (DOE 1996b) as:

$$Total\ cellulosics\ (kg) = actual\ cellulosics\ (kg) + 1.7\ plastics\ (kg) + rubbers\ (kg)$$

The materials in the RH inventory are obtained from the *Transuranic Waste Baseline Inventory Report, Revision 3* (DOE 1996c) and are summarized in Table 3.

Table 3. Mass of Cellulose, Rubber, Plastic and Cellulosics Equivalents in RH Inventory

Material	Mass in RH Inventory (kg)	Equivalent Cellulosics (kg)
Cellulose	1.2036×10^5	1.2036×10^5
Rubber	0.2336×10^5	0.2336×10^5
Plastic	1.2815×10^5	2.1786×10^5
Total	$\mathbf{2.7187 \times 10^5}$	$\mathbf{3.6158 \times 10^5}$

The number of RH canisters to be disposed at WIPP is assumed to be 7,955 (DOE 1995). Therefore the average mass of cellulosics per RH canister is 3.6158×10^5 kg cellulosics / 7,955 canisters or 45.4 kg cellulosics / RH canister. Assuming a microbial gas generation rate of 0.01 mole/kg cellulosics/year, which is the same rate used for CH-TRU waste under humid conditions in Appendix D9 of the *WIPP RCRA Part B Permit Application* (DOE 1996a), the microbial gas generation rate of a single RH canister (MGGR) is:

$$MGGR = (0.01\ mole/kg\ cellulosics/yr)\ 45.4\ kg\ cellulosics/RH\ canister$$

$$MGGR = 0.45\ mole/yr$$

2.3.2 Anoxic Corrosion

Anoxic corrosion of iron and aluminum alloys in TRU waste has the potential to consume water and produce hydrogen, assuming several repository conditions are present (DOE 1996b). The primary conditions that must be satisfied for anoxic corrosion to occur are (1) sufficient quantities of brine from the surrounding Salado Formation enter the WIPP disposal rooms after closure and/or (2) initial water in the waste is available. Gas generation rates from anoxic corrosion for CH-TRU and RH-TRU wastes are similar because there are no significant differences between these waste forms that would directly influence corrosion.

RH-TRU corrodible metals (i.e., RH-TRU iron, aluminum, and waste packaging) will contribute 6 percent by mass and 31 percent by mass assuming a corrodible shield plug to the total corrodible metal content (i.e., all TRU iron, aluminum, and waste packaging) of the repository (DOE 1995). However, if sufficient brine is available, microbial degradation will produce carbon dioxide and/or hydrogen sulfide (in addition to other gases) that could potentially passivate steels and other iron-base alloys and thus prevent additional hydrogen production and water consumption from anoxic corrosion of these waste metals. Further, small amounts of brine could initiate anoxic corrosion, which will produce hydrogen, consume water, increase the pressure, and perhaps slow or prevent additional brine inflow or even cause brine outflow, thus impeding additional anoxic corrosion and hydrogen generation. Thus, the availability of water in the WIPP repository will limit anoxic corrosion and therefore hydrogen generation, regardless of the quantity of CH-TRU and RH-TRU steels and other iron-base alloys and packaging materials included in the WIPP inventory (DOE 1995). Therefore, the anoxic humid steel corrosion rate during the operational period of the WIPP for the cases with microbial gas generation is 0.0 μm/yr or 0.0 mole/yr (DOE 1996b).

2.3.3 Radiolysis of Waste Materials

Gas generation from alpha radiolysis is not as important as anoxic corrosion and anaerobic microbial degradation because results from radiolysis studies indicate that gas generation rates from alpha radiolysis are substantially lower than rates from anoxic corrosion and anaerobic microbial degradation (DOE 1995). Given the high energies of the gamma rays and the fairly low density of the waste matrix, only a small fraction of the gamma energy will actually be deposited within the waste. The majority of radiolytic gas production is attributable to alpha and beta radiation, similar to that for CH-TRU wastes. Because the RH-TRU waste is comprised of lower percentages of cellulosics, rubber, and plastic materials than in CH-TRU wastes, the potential for radiolysis in RH wastes is actually somewhat lower than that for CH wastes. Preliminary data on gas generation measurements of RH TRU waste canisters at the Los Alamos National Laboratory (LANL 1999) indicate very low rates of gas generation and in fact the consumption rate of oxygen in the canisters may be higher than the net rate of gas generation. Because radiolysis of CH-TRU waste materials has been shown to be insignificant relative to anoxic corrosion and microbial gas generation, radiolysis of RH-TRU waste materials will also be insignificant relative to these mechanisms.

2.3.4 Gas Displacement

The rate of gas displacement within the RH canister borehole excavation is based on the data from the WIPP Part B Permit Application, Appendix D9 *Exposure Assessment for Protection of the Atmosphere* (DOE 1996a). Specifically, the percentage volume reduction rate of the borehole is conservatively assumed to be the same percentage as the reduction in panel volume. Because the borehole geometry is cylindrical and the dimensions are much smaller than the panel, the actual borehole volume reduction rate will actually be smaller than that based on the panel value.

According to Appendix D9, the reduction of the panel void volume is 812 m^3/yr/panel.

The initial panel volume is calculated from the following equation (DOE 1991)

$$V(0)_{panel} = 7hwl + 12hwd + 14hw^2$$

where,

h	=	height of room (13 ft)
w	=	width of room (33 ft)
l	=	length of room (300 ft)
d	=	width of pillar (100 ft)

and the initial panel volume is:

$$V(0)_{panel} = 1{,}613{,}898\ ft^3\ /\ panel = 45{,}700\ m^3\ /\ panel$$

The percentage volume reduction, PVR is calculated as:

$$PVR = \frac{812\ m^3\ /\ panel\ /\ yr}{45{,}700\ m^3}\ x\ 100\% = 1.778\%\ /\ year$$

This percentage volume reduction will be applied to the borehole to calculate the molar (gas) displacement rate.

Volume of Borehole

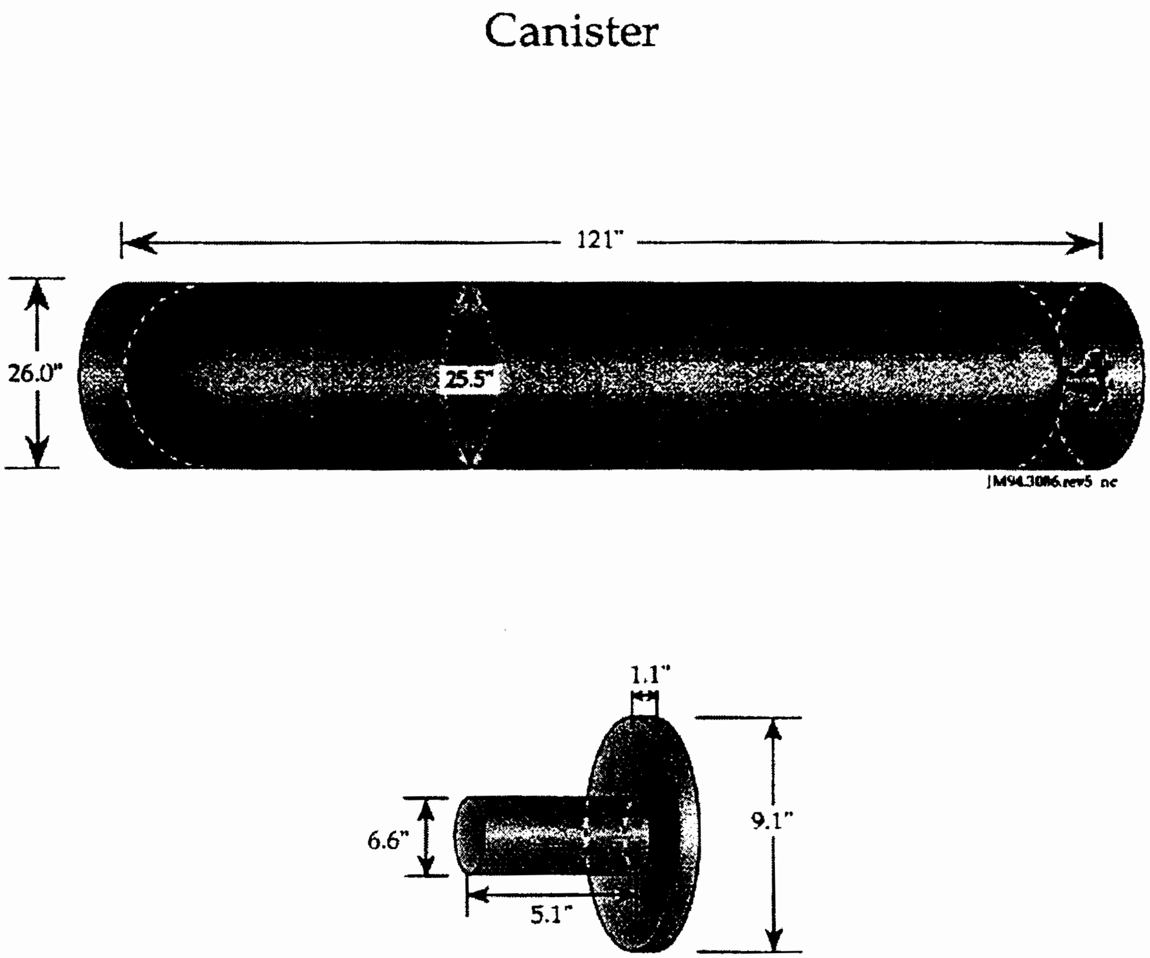
The diameter of a borehole excavation will be 30 in or 76.2 cm. Thus the radius of the excavation, $r_{borehole}$, will be 38.1 cm. The length of a borehole, $l_{borehole}$, is 16 ft or 487.68 cm (DOE 1995). Thus, the initial volume of the borehole excavation will be:

$$V(0)_{borehole} = \pi\ r_{borehole}^{\ 2}\ l_{borehole} = \pi\ (38.1\ cm)^2 (487.68\ cm)(1\ m^3\ /\ 10^6\ cm^3) = 2.2240\ m^3$$

External Volume of Canister

The dimensions of the canister and pintle are shown in Figure 1 (DOE 1995).

Figure 1. Dimensions of Canister and Pintle



Note:
Drawing Not to Scale
* These are nominal estimates which support the inventory assessment for corrodible metals.

The external volume of the canister is calculated as:

$$V_{canister} = \pi\, r_{canister}{}^{2}\, l_{canister} = \pi\,(26\,in/2)^2(121\,in - 6.2\,in) = 60{,}951\,in^3$$

The volume occupied by the pintle is:

$$V_{pintle} = \pi\,[(6.6\,in/2)^2(5.1\,in) + (9.1\,in/2)^2(1.1\,in)] = 246\,in^3$$

Thus, the total volume occupied by the canister and pintle is 61,197 in^3 or 1.0028 m^3.

<u>External Volume of Shield Plug</u>

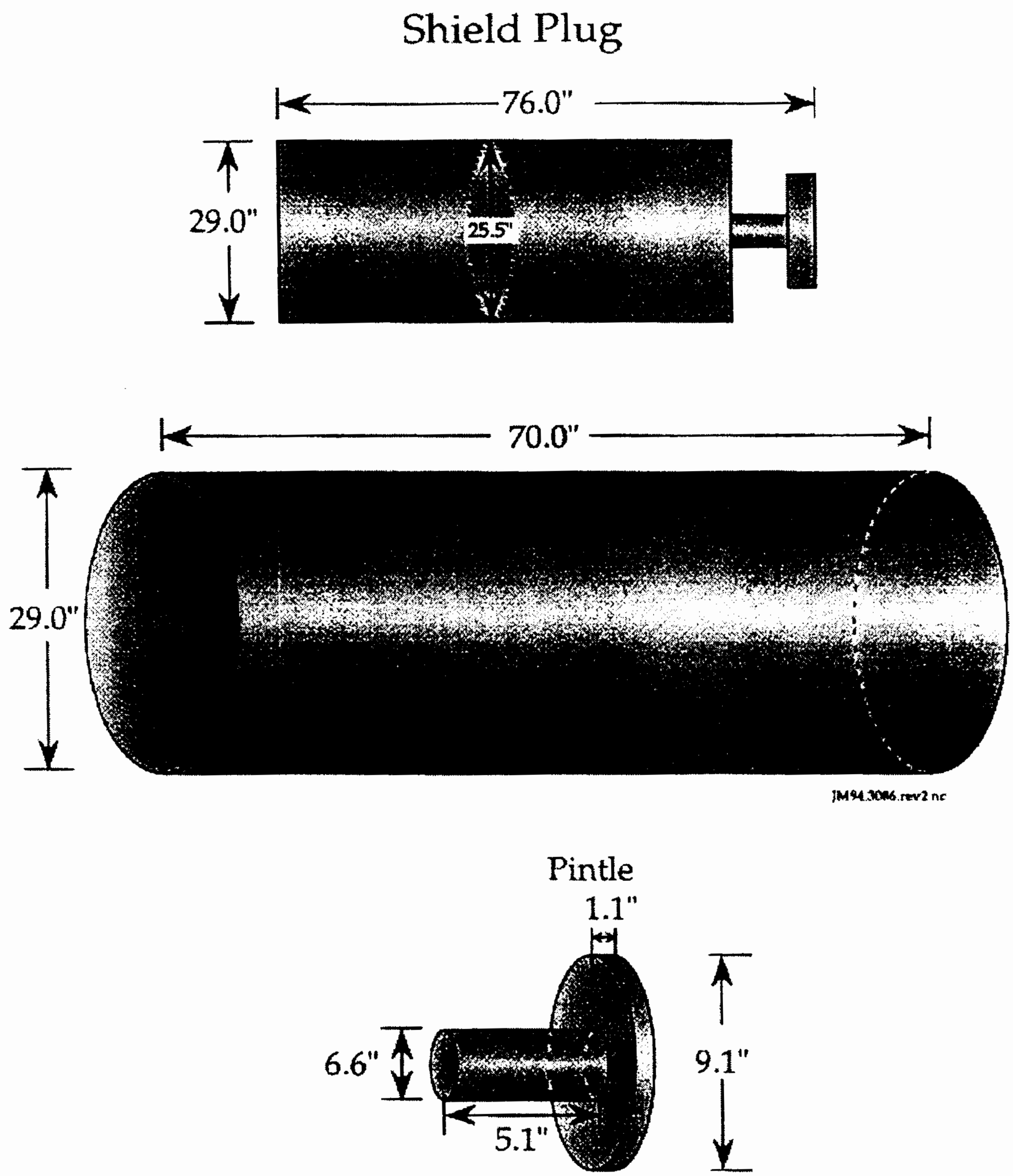
The dimensions of the shield plug and pintle are shown in Figure 2 (DOE 1995).

The external volume of the shield plug is calculated as:

$$V_{shieldplug} = \pi\, r_{shieldplug}^{\;2}\, l_{shieldplug} = \pi\,(29\,in/2)^2(70\,in) = 46{,}236\,in^3 = 0.7577\,m^3$$

The volume occupied by the pintle is 246 in^3. Thus, the total volume occupied by the shield plug and pintle is 46,482 in^3 or 0.7617 m^3.

Figure 2. Dimensions of Shield Plug and Pintle



Note:
Drawing Not to Scale
* These are nominal estimates which support the inventory assessment for corrodible metals.

Void Volume Inside Borehole

The void volume within the excavation at time, t, is calculated as:

$$V_V(t) = V_{borehole}(t) - (V_{canister} + V_{pintle}) - (V_{shield\ plug} + V_{pintle})$$

The initial void volume is calculated as:

$$V_V(0) = 2.2240\ m^3 - 1.0028\ m^3 - 0.7617\ m^3 = 0.4595\ m^3$$

The borehole volume at 1 year is calculated assuming a percentage volume reduction of 1.778% as:

$$V_{borehole}(1\ yr) = (1 - 0.01778)\ V_{borehole}(0) = 0.98222\ (2.2240\ m^3) = 2.1844\ m^3$$

The borehole void volume at 1 year is calculated as:

$$V_V(1\ yr) = 2.1844\ m^3 - 1.0028\ m^3 - 0.7617\ m^3 = 0.4199\ m^3$$

The reduction of the borehole excavation void volume in one year is therefore 0.4595 m^3 – 0.4199 m^3 or 0.0396 m^3/yr.

The volumetric reduction rate is converted into a molar (gas) displacement rate, GDR, using the ideal gas law as:

$$GDR = 0.0396\ m^3 / yr\ x\ \frac{P}{R\,T}$$

$$GDR = (0.0396\ m^3 / yr)(10^3\ L / m^3)\ x\ \frac{1\ atm}{(\frac{0.08206\ atm\ L}{mol\ K})(303\ K)}$$

$$GDR = 1.59\ mol / yr$$

2.3.5 Total Gas Pressurization Rate

The total gas pressurization rate or effective gas generation rate (microbial gas generation rate plus gas displacement rate) per RH canister borehole is calculated as follows, which is analogous to Equation D9-3 from Appendix D9, *Exposure Assessment for Protection of the Atmosphere* (DOE 1996a):

GR = MGGR + GDR

OR

GR = 0.45 mol/yr + 1.59 mol/yr = 2.04 mol/yr

2.4 Maximum RH Canister VOC Emission Rates

The individual canister VOC emission rate is calculated as:

$$ICER_{VOC} = GR \ MF_{VOC}$$

where,

$ICER_{VOC}$= Individual canister VOC emission rate (mole/drum/year)
GR = Effective canister total gas generation (i.e., pressurization) rate (2.04 mole/canister/year)
MF_{VOC} = VOC mole fraction in canister headspace (dimensionless)

The total emission rate of a VOC into a room from all canisters is calculated as:

$$TCER_{VOC} = N_C \ ICER_{VOC}$$

where,

N_C = Number of RH canisters per room (120 canisters).

3.0 RESULTS

The allowable room emission rates for the VOCs are summarized in Table 4. VOC concentrations in the canister headspace based on saturated vapor pressure values are listed in the third column of Table 4. The individual canister VOC emission rates, ICER, and the VOC emission rates for all canisters in a room, TCER, are listed in Columns 4 and 5 of the table. The individual TCER values were divided by the allowable VOC room emission rates to establish the magnitude of the RH canister emissions contributions. The percentages contributions range from 0.09% for chlorobenzene to 8.23% for 1,1-dichloroethene.

Table 4. Maximum RH Canisters VOC Emission Rates

Compound	Current Maximum Allowable VOC Emission Rate (mole/room/year)	Vapor Pressure VOC Concentration (ppmv)	Canister Emission Rate (mole/canister/year)	Room Emission Rate (mole/room/year)	Percentage of Current Maximum Allowable Room Emission Rate
Carcinogens					
Carbon Tetrachloride	4,250	185,800	0.379	45.5	1.07%
Chloroform	4,860	317,200	0.650	77.6	1.60%
1,1-Dichloroethene	2,800	940,800	1.930	230	8.23%
1,2-Dichloroethane	1,160	130,900	0.268	32.0	2.76%
Methylene Chloride	53,650	683,000	1.40	167	0.31%
1,1,2,2-Tetrachloroethane	1,300	9,400	0.0194	2.3	0.18%
1,1,1-Trichloroethane	14,880	200,900	0.412	49.2	0.33%
Noncarcinogens					
Chlorobenzene	5,500	20,800	0.0426	5.10	0.09%
Toluene	4,780	47,800	0.0979	11.7	0.24%

4.0 IMPLEMENTATION

To conservatively account for potential VOC emissions from RH-TRU waste, the current maximum allowable VOC emission rate values must be reduced. Therefore, the maximum allowable VOC emission rates currently in the permit must be adjusted to reflect the potential contributions from RH-TRU waste as shown in Table 5.

Table 5. Maximum VOC Emission Rates Accounting for Potential RH-TRU Waste Emissions

Compound	Current Maximum Allowable VOC Emission Rate (mole/room/year)	Adjusted Maximum Allowable VOC Emission Rate (mole/room/year)
Carcinogens		
Carbon Tetrachloride	4,250	4,204
Chloroform	4,860	4,782
1,1-Dichloroethene	2,800	2,569
1,2-Dichloroethane	1,160	1,127
Methylene Chloride	53,650	53,482
1,1,2,2-Tetrachloroethane	1,300	1,297
1,1,1-Trichloroethane	14,880	14,830
Noncarcinogens		
Chlorobenzene	5,500	5,494
Toluene	4,780	4,768

5.0 CONCLUSION

A conservative approach to calculating the potential VOC emissions from RH-TRU waste in a room was developed to bound the effects of RH-TRU waste on total room emissions. Based upon the conservative assumptions used to bound the RH-TRU waste VOC emissions, the RH-TRU waste could contribute a maximum of 0.09% (for chlorobenzene) to 8.23% (for 1,1-Dichloroethene) for any of the VOCs of concern. Because the contributions from the RH-TRU waste are so small, the existing maximum VOC emissions rates were reduced to account for the RH-emissions indirectly. This approach eliminates the need for any direct measurements of the headspace gases in RH-TRU waste canisters by conservatively incorporating the maximum possible VOC contribution from RH-TRU waste in the maximum allowable VOC emission limit in the Permit.

6.0 REFERENCES

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U.S. Department of Energy

Washington, D.C.

ORDER

DOE O 435.1

Approved: 7-09-99
Review: 7-09-01

SUBJECT: RADIOACTIVE WASTE MANAGEMENT

1. OBJECTIVE. The objective of this Order is to ensure that all Department of Energy (DOE) radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment.

2. CANCELLATION. This Order cancels DOE 5820.2A, RADIOACTIVE WASTE MANAGEMENT, dated 9-26-88. Cancellation of that Order does not, by itself, modify or otherwise affect any contractual obligation to comply with the Order. The provisions of this canceled Order which have been incorporated by reference in a contract shall remain in effect until the contract is modified.

3. APPLICABILITY.

   a. DOE Elements. This Order applies to all DOE elements except as stated in item "d."

   b. Radioactive Waste. Except as stated in item "d," this Order applies to the management of:

      (1) All high-level waste, transuranic waste, and low-level waste, including the radioactive component of mixed waste, for which DOE is responsible;

      (2) DOE accelerator-produced radioactive waste; and

      (3) If managed at DOE low-level waste facilities, byproduct materials as defined by section 11e.(2) of the *Atomic Energy Act of 1954*, as amended, or naturally occurring radioactive materials.

   c. Contractors. The Contractor Requirements Document, Attachment 1, sets forth requirements to be applied to contractors performing work that involves management of DOE radioactive waste at DOE-owned or leased facilities. Contractor compliance with the Contractor Requirements Document will be required to the extent set forth in a contract.

Distribution:
All Departmental Elements

Initiated By:
Office of Environmental Management

d. Exemptions. This Order does not apply to certain DOE programs, facilities, or activities as described below.

(1) This Order does not apply to activities conducted under the authority of the Director, Naval Nuclear Propulsion Program, as described in Department of Energy *National Security and Military Applications of Nuclear Energy Authorization Act of 1985*, Public Law 98-525.

(2) Requirements in this Order that overlap or duplicate requirements of the Nuclear Regulatory Commission (NRC) related to radiation protection, nuclear safety (including quality assurance), and safeguards and security of nuclear material, do not apply to the design, construction, operation, and decommissioning of Office of Civilian Radioactive Waste Management facilities as defined in DOE O 250.1, *Civilian Radioactive Waste Management Facilities – Exemptions from Departmental Orders*.

(3) Requirements in this Order that duplicate or conflict with requirements of NRC or an Agreement State do not apply to facilities and activities licensed by the NRC or an Agreement State.

(4) Requirements in this Order that duplicate or conflict with the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended, Public Law 102-579, including the U.S. EPA's Possessive Certification of the WIPP pursuant to this Act, do not apply to the operation of the Waste Isolation Pilot Plant or the disposal of waste therein.

(5) Unless managed in a low-level waste facility, requirements in this Order do not apply to byproduct material as defined in section 11e.(2) of the *Atomic Energy Act of 1954*, as amended, or naturally occurring radioactive material.

(6) This Order does not apply to either spent nuclear fuel or non-waste materials.

(7) Upon request or on its own initiative, DOE may grant exemptions from the requirements of this Order in accordance with the process provided by DOE M 251.1-1A, *Directives System Manual*, as applicable.

4. REQUIREMENTS.

a. DOE radioactive waste management activities shall be systematically planned, documented, executed, and evaluated.

b. Radioactive waste shall be managed to:

(1) Protect the public from exposure to radiation from radioactive materials. Requirements for public radiation protection are in DOE 5400.5, *Radiation Protection of the Public and the Environment.*

(2) Protect the environment. Requirements for environmental protection are in DOE 5400.1, *General Environmental Protection Program*, and DOE 5400.5, *Radiation Protection of the Public and the Environment.*

(3) Protect workers. Requirements for radiation protection of workers are in 10 CFR Part 835, *Occupational Radiation Protection*; requirements for industrial safety are in DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees.*

(4) Comply with applicable Federal, State, and local laws and regulations. These activities shall also comply with applicable Executive Orders and other DOE directives.

c. All radioactive waste shall be managed in accordance with the requirements in DOE M 435.1-1, *Radioactive Waste Management Manual.*

d. DOE, within its authority, may impose such requirements, in addition to those established in this Order, as it deems appropriate and necessary to protect the public, workers, and the environment, or to minimize threats to property.

5. <u>RESPONSIBILITIES</u>. All DOE elements as specified in 3.a are responsible for implementing the requirements of this Order. See DOE M 435.1-1, *Radioactive Waste Management Manual,* for specific responsibilities.

6. <u>REFERENCES</u>. DOE M 435.1-1, *Radioactive Waste Management Manual* of 7-09-99 and DOE G 435.1-1, *Implementation Guide for DOE M 435.1-1.*

7. <u>CONTACT</u>. Questions concerning this Order should be addressed to the Office of Waste Management at (202) 586-0370.

BY ORDER OF THE SECRETARY OF ENERGY:

THOMAS T. TAMURA
Acting Director of
Management and Administration

CONTRACTOR REQUIREMENTS DOCUMENT

1. In the performance of this contract, the contractor is required to:

   A. Systematically plan, document, execute, and evaluate the management of DOE radioactive waste and assist the government in planning, executing and evaluating the management of DOE radioactive waste in accordance with the requirements of DOE O 435.1, *Radioactive Waste Management*.

   B. Assist the government in managing DOE radioactive waste so as to:

      (1) Protect the public from exposure to radiation from radioactive materials.

      (2) Protect the environment.

      (3) Protect workers including following requirements for radiation protection.

   C. Assist DOE in meeting its obligations and responsibilities under Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements,* and Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition,* and *The Pollution Prevention Act of 1990.*

   D. Comply with the requirements in DOE M 435.1-1, *Radioactive Waste Management Manual*, unless such activities are specifically exempted by DOE O 435.1, Section 3.d., as described below.

      (1) Activities conducted under the authority of the Director, Naval Nuclear Propulsion Program, as described in Department of Energy *National Security and Military Applications of Nuclear Energy Authorization Act of 1985*, Public Law 98-525.

      (2) Requirements that overlap or duplicate requirements of the Nuclear Regulatory Commission (NRC) related to radiation protection, nuclear safety (including quality assurance), and safeguards and security of nuclear material, do not apply to the design, construction, operation, and decommissioning of Office of Civilian Radioactive Waste Management facilities as defined in DOE O 250.1, *Civilian Radioactive Waste Management Facilities – Exemptions from Departmental Orders.*

(3) Requirements that duplicate or conflict with requirements of NRC or an Agreement State do not apply to facilities and activities licensed by the NRC or an Agreement State.

(4) Requirements that duplicate or conflict with the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended, Public Law 102-579, do not apply to the operation of the Waste Isolation Pilot Plant or the disposal of waste therein.

(5) Unless managed in a low-level waste facility, requirements in DOE O 435.1 do not apply to byproduct material as defined in section 11e.(2) of the *Atomic Energy Act of 1954*, as amended, or naturally occurring radioactive material.

(6) Spent nuclear fuel or non-waste materials.

(7) Upon request or on its own initiative, DOE may grant exemptions from the requirements of DOE O 435.1 in accordance with the process provided by DOE M 251.1-1A, *Directives System Manual*.

E. Incorporate these requirements into the contracts of all sub-contractors which are involved in the management of DOE radioactive waste.

IMPLEMENTATION GUIDE

for use with DOE M 435.1-1

Chapter III

Transuranic Waste Requirements

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III. A. **Definition of Transuranic Waste.**

Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for:

(1) High-level radioactive waste;

(2) Waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or

(3) Waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Objective:

The objective of this requirement is to provide the criteria for determining if a waste is to be managed in accordance with DOE M 435.1-1, Chapter III, *Transuranic Waste Requirements*. Additionally, it is necessary to determine if a waste meets the definition of transuranic waste to enable the Department of Energy to comply with provisions in the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended.

Discussion:

Basis. This definition of transuranic waste is the definition used in the *Waste Isolation Pilot Plant* (WIPP) *Land Withdrawal Act of 1992*, as amended. This definition is functionally equivalent to that in 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*. The *WIPP Land Withdrawal Act of 1992*, as amended, defines transuranic waste and limits disposal at WIPP to transuranic waste resulting from atomic energy defense activities which meets this definition.

Interpretation and Application. In order to ensure consistent application, various terms used in the definition need to be clarified. First, the limit above which a waste is determined to be transuranic waste is based on an activity of 100 nanocuries (nCi) (3700 becquerels (Bq)) per gram of waste. The activity to be counted in making this determination is only that from the isotopes that would qualify a waste as transuranic waste as described in the following paragraphs. In other words, one would not include the activity from short-lived fission products (i.e., non-alpha emitters with half-lives less than 20 years) in calculating the concentration. The mass over which

the activity is divided in making the waste determination is the waste matrix. This includes the waste material itself as well as any stabilization media that must be added to meet waste acceptance criteria for mobility, physical form, structural stability or free liquids. The mass of added shielding, the container, or any rigid liners is not included in the calculation.

The term transuranic means those elements with an atomic number greater than that of uranium (i.e., atomic number >92). Therefore, uranium wastes do not qualify as transuranic waste by virtue of their uranium concentration.

The transuranic radionuclides that are to be considered in making a transuranic waste determination must decay by emission of alpha particles and also must have a half-life greater than 20 years. Consistent with this portion of the definition, there are radionuclides with atomic numbers greater than 92 that would not cause a waste to be called transuranic waste.

> *Example: A waste is contaminated with americium-242 which predominantly decays by emission of a beta particle and has a 16-hour half-life. Even though americium-242 has an atomic number greater than 92, it cannot be considered in determining the waste type because it is not an alpha emitter and does not have a 20-year half life.*

Given the definition provided in the public law and its application pursuant to DOE M 435.1-1, the determination of transuranic waste should be made at the time of waste certification, that is, each time the waste is transferred to another person or facility (see guidance for DOE M 435.1-1, Section III.J).

> *Example 1: A waste is contaminated with curium-244 which is an alpha-emitter and has an atomic number greater than 92. Over a period of about 200 years, a sufficient inventory of curium-244 will decay to greater than 100 nCi/g of plutonium-240, an alpha emitter with a 6,750-year half-life. Regardless of the decay product, the curium-244 content of the waste is not relevant to the determination of whether the waste is transuranic because the curium has an 18.11-year half-life and the determination is made at the time the waste is certified as meeting a facility's waste acceptance criteria. However, even if the waste is determined to be a low-level waste, the method of disposal must be commensurate with the long-term hazard associated with the plutonium-240 decay product.*

> *Example 2: A waste is generated and placed in bags within 55-gallon drums. The waste has been characterized and certified as transuranic waste in accordance with the waste acceptance criteria of the facility receiving the waste. This same waste, if required to undergo solidification to enable shipment and disposal, could be re-certified after treatment by the treating facility as low-level waste, in the event that radioassay found*

that the solidification process reduced the concentration of relevant radioisotopes to less than 100 nCi (3700 Bq) per gram of waste matrix.

In the previous example, the waste form would be altered by the addition of solidifying agents that would be considered in the radioassay. In either of the two cases in the previous example, the determination would not consider the waste container or its rigid liner. Even if a waste container fails and has to be overpacked, the mass of the failed container does not need to be included in the transuranic waste determination.

Example: A 55-gallon drum is damaged, has leaked, and requires overpacking. The concentration determination would include the weights of the original waste matrix and interior bags, but not the weight of the failed drum.

It is also conceivable that a low-level waste could become sufficiently concentrated that it becomes a transuranic waste.

Example: A waste with a relatively high concentration of transuranic radionuclides (but less than 100 nCi (3700 Bq) per gram) is transferred to a treatment facility as low-level waste. The thermal treatment of the waste reduces the mass of the waste matrix enough that the resulting transuranic concentration exceeds 100 nCi (3700 Bq) per gram. If no additional treatment (e.g., stabilization) were necessary, the resulting waste would be categorized as transuranic waste.

Determining whether waste exceeds the 100 nCi/g (3700 Bq/g) shall be in accordance with the requirements and guidance issued by the Carlsbad Area Office in the *Transuranic Waste Characterization Quality Assurance Program Plan*, *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, and/or other controlling documents. Waste which does not exceed the 100 nCi/g limit is to be managed in accordance with the low-level waste requirements of DOE M 435.1-1.

Dilution of a transuranic waste stream to reclassify the waste as low-level waste (i.e., reducing the concentration to less than or equal to 100 nCi (3700 Bq) per gram) is not permitted by the Department. While it is recognized that in the course of stabilizing a waste stream some changes in waste concentration may occur, actions to dilute a waste stream below the concentration limits for transuranic waste are prohibited. It is also recognized that actions taken to process a waste stream for safety or technological reasons that are justified, may result in the waste being reclassified after processing as low-level waste.

Example: Due to the moisture content of a transuranic waste sludge, the waste does not meet the WIPP WAC. The site evaluates several treatment options taking into consideration factors such as worker exposure, waste minimization, cost and complexity

of the treatment process and disposal facility waste acceptance requirements. The treatment process selected involves adding grout to the transuranic waste sludge to eliminate free liquids resulting in a solidified waste form that contains transuranic radionuclides in concentrations less than 100 nCi (3700 Bq) per gram and meets the waste acceptance criteria for a low-level waste disposal facility.

There are three exceptions to the definition of transuranic waste: the high-level waste exception; the degree of isolation exception; and the NRC-approved disposal exception.

High-Level Waste Exception. The definition of transuranic waste includes exceptions for some wastes that would otherwise be considered transuranic waste. The first exception to the definition of transuranic waste is waste that meets the definition of high-level waste (see Definition of High-Level Waste guidance). Because high-level waste is generated by reprocessing spent nuclear fuel, much high-level waste contains concentrations of greater than 100 nCi (3700 Bq) per gram alpha-emitting radionuclides with half-lives greater than 20 years. Separate requirements apply to management of high-level waste, both within and external to DOE. This exception serves to distinguish high-level waste, as defined in DOE M 435.1-1, Chapter II, from transuranic waste.

Example: Waste in underground storage tanks at the Hanford Site contains long-lived, alpha-emitting plutonium and neptunium isotopes in excess of 100 nCi (3700 Bq) per gram. However, the waste is not categorized as transuranic waste because it is highly radioactive waste from reprocessing spent nuclear fuel; i.e., it is high-level waste.

Degree of Isolation Exception. The second exception to the definition of transuranic waste is waste that is determined to not need the degree of isolation that is provided by implementation of the disposal requirements of 40 CFR Part 191. This allows the Secretary of Energy to make a determination to remove these wastes from the transuranic waste definition based on an evaluation of a proposed disposal concept. Such a determination would have to be submitted to and concurred with by the EPA Administrator.

Example: A site is contemplating on-site disposal of a small quantity of a unique waste contaminated with greater than 100 nCi (3700 Bq) per gram of transuranic alpha-emitters with greater than 20-year half-lives. Site personnel submit a rationale for applying standards other than those for transuranic waste disposal, a conceptual disposal design, and a preliminary radiological impacts analysis to the cognizant Headquarters Program Office. The Program Office confers with the Offices of Environmental Management and Environment, Safety, and Health on the proposal. The Headquarters staff agrees with the site's approach, so the Office of Environment, Safety, and Health arranges a meeting with the Environmental Protection Agency. The meeting results in an agreement on the analyses that need to be conducted and the radiological performance measures that apply. Site personnel conduct the analyses, which project

that the performance measures will be met. The analyses are reviewed by Headquarters staff, then by EPA staff. Following resolution of any concerns, the Secretary of Energy determines, and the EPA Administrator concurs, that the waste does not need to be considered transuranic waste, but can be disposed of as low-level waste.

NRC-Approved Disposal Exception. Under the current regulatory regime, this exception does not affect DOE's management of defense transuranic waste that is to be disposed of at WIPP. This exception gives the Nuclear Regulatory Commissioning (NRC) the latitude to not apply the disposal standards of 40 CFR Part 191 to waste which meets the concentration limits of transuranic waste if the waste is disposed of in an NRC-licensed facility. Waste generated by commercial activities could have concentrations of radionuclides that would result in categorization as transuranic waste. As long as the waste is not high-level waste, it could be accepted as Greater-than-Class-C low-level waste per the waste classification system in 10 CFR 61.55. In accordance with the *Low-Level Radioactive Waste Policy Act*, as amended, the Department is responsible for disposal of Greater-than-Class-C waste; however, disposal of Greater-than-Class C waste generated by an NRC licensee is to be in a facility licensed by the NRC.

The NRC issued a final rule requiring the disposal of Greater-than-Class C low-level radioactive waste in a geologic repository, unless disposal has been approved elsewhere (54 FR 22578, codified at 10 CFR Part 61). The rulemaking clarified that only the requirements governing disposal of high-level radioactive waste in geologic repositories (10 CFR Part 60) would be relevant to disposal of Greater-than-Class C waste in a geologic repository. Although the NRC has indicated that the disposal of Greater-than-Class C waste in near-surface disposal facilities is generally not acceptable, the requirements of 10 CFR Part 61 would be applicable to the disposal of commercially generated (NRC licensed) Greater-than-Class C waste in "intermediate" disposal facilities. The exception to the definition allows NRC to authorize such waste to be disposed without necessarily invoking the additional requirements of 40 CFR Part 191.

Supplemental References:

1. Cowan, 1996. Stephen P. Cowan to Distribution, memorandum, *Implementation Guidance Concerning "Atomic Energy Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, U.S. Department of Energy, October 17, 1996.

2. NRC. *Disposal of High-Level Radioactive Wastes in Geologic Repositories,* 10 CFR Part 60, U.S. Nuclear Regulatory Commission, Washington, D.C.

3. NRC. *Licensing Requirements for Land Disposal of Radioactive Waste,* 10 CFR Part 61. U.S. Nuclear Regulatory Commission, Washington, D.C.

4. *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended, October 30, 1992.

5. *Low-Level Radioactive Waste Policy Amendments Act of 1985*, as amended, January 15, 1986.

6. CAO, 1998. *U.S. Department of Energy, Transuranic Waste Characterization Quality Assurance Program Plan,* Revision 1, CAO-94-1010, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, December 18, 1998.

7. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

8. NRC, 1989. "Final rule, 10 CFR Part 61, Disposal of Radioactive Waste," *Federal Register*, Vol. 54, No. 100, U.S. Nuclear Regulatory Commission, Washington, D.C., May 25, 1989.

9. EPA, 1985. "Final rule, 40 CFR Part 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 50, No. 182, U.S. Environmental Protection Agency, Washington, D.C., September 19, 1985.

III. B. Management of Specific Wastes.

The following provide for management of specific wastes as transuranic waste in accordance with the requirements in this Chapter:

(1) Mixed Transuranic Waste. Transuranic waste determined to contain both a hazardous component subject to the *Resource Conservation and Recovery Act* (RCRA), as amended, and a radioactive component subject to the *Atomic Energy Act of 1954*, as amended, shall be managed in accordance with the requirements of RCRA and DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. Transuranic waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(3) Pre-1970 Transuranic Waste. Transuranic waste disposed of prior to implementation of the 1970 Atomic Energy Commission Immediate Action Directive regarding retrievable storage of transuranic waste is not subject to the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Objective:

The objective of this requirement is to ensure that DOE transuranic waste is managed in accordance with the applicable requirements of external regulations, specifically those of the *Resource Conservation and Recovery Act* and the *Toxic Substances Control Act*, that address non-radiological hazards, in addition to being managed in accordance with the requirements of DOE O 435.1 and the *Radioactive Waste Management Manual*, DOE M 435.1-1.

Discussion:

The *Radioactive Waste Management Manual*, DOE M 435.1-1, contains requirements for managing the radioactive character of transuranic waste. Through the safety and hazards analysis process used in developing the Manual, non-radiological hazards associated with managing certain wastes were identified. During development of the requirements necessary to control the identified hazards, it was concluded that sufficient external regulations, promulgated pursuant to *Resource Conservation and Recovery Act* (RCRA) and *Toxic Substances Control Act* (TSCA), exist for controlling the non-radiological hazard.

In managing transuranic waste which are subject to RCRA and TSCA requirements, personnel should be aware of the requirements for storage and disposal of the waste. The ability to dispose of RCRA and TSCA waste that has a radioactive component is limited. The expectation is that certain mixed wastes can be disposed of at WIPP without treatment (refer to the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*). Currently, no disposal facilities are available for TSCA-regulated transuranic wastes. Therefore, to the extent practical, waste generators should avoid generating mixed or TSCA-regulated transuranic waste, and generators and waste managers should avoid actions (e.g., commingling wastes with different regulatory requirements) that result in transuranic waste with no path to disposal (see guidance for DOE M 435.1-1, Section I.2.F.(19)).

> *Example: According to the Waste Acceptance Criteria for the Waste Isolation Pilot Plant, PCBs in concentrations greater than 50 ppm cannot be accepted for disposal. Therefore, in performing work involving PCBs (e.g., activities creating waste or waste management such as packaging) care should be taken to avoid commingling PCB contaminated materials with transuranic or mixed transuranic waste. Commingling the wastes could potentially result in a larger volume of waste with no path to disposal. Careful control and segregation of the PCB-contaminated material would result in a relatively small volume of waste that cannot be disposed of and the rest of the waste being eligible for disposal at WIPP.*

<u>RCRA and State Hazardous Waste Regulations</u>. *Resource Conservation and Recovery Act* required the Environmental Protection Agency to promulgate regulations for management of hazardous waste. The Act also provides for states to promulgate and implement hazardous waste regulatory programs that are at least as protective as the Federal program. The hazardous waste requirements that personnel must follow in managing (i.e., generating, transporting, treating, storing or disposing) mixed transuranic waste and in closing affected facilities are primarily in 40 CFR Parts 260 through 270, or authorized state regulations. A variety of guidance manuals and information relevant to the management of the hazardous component of mixed transuranic waste has been prepared both by the state regulatory agencies and the Environmental Protection Agency (see, for example, *U.S. Environmental Protection Agency, Catalog of Hazardous and Solid Waste Publications, EPA530-B-96-007, September, 1996)*. These guidance documents should be consulted when developing management programs for mixed transuranic waste.

Hazardous waste regulations promulgated by States with RCRA authority may be more restrictive than the Federal regulations. The more restrictive requirements may include more waste than the Federal requirements or may impose another state's definition of hazardous waste when waste is received from that state. Waste management personnel therefore need to be aware of the requirements of the regulations in their own state as well as the implications of the regulations in states to which they intend to transfer waste.

Example 1: In a state that invokes requirements equivalent to the EPA hazardous waste regulations, waste oil that meets the radiological criteria for being transuranic waste would not be managed as mixed waste. However, if the oil was to be shipped to another state in which the state-passed regulations had expanded the definition of hazardous waste to include waste oil, the waste would have to be packaged, manifested, transported and stored as a mixed waste.

Example 2: If the direction of waste transfer in the above example were reversed, a different situation could arise. The waste would be declared a mixed waste in the state of origin because the state regulations had a broader definition of hazardous waste. The state to which it was to be shipped did not specifically regulate waste oil as a hazardous waste. However, it may be that the state regulations require that waste be considered to be categorized as it was in the state of origin. Then the waste would still be considered mixed waste even after it was shipped to the state that did not explicitly regulate waste oils.

The RCRA requirements prohibit storage of hazardous (including mixed) waste restricted from land disposal except for purposes of accumulating sufficient quantities to facilitate recovery, treatment, or disposal. Capabilities and capacities to treat DOE mixed waste to the land disposal restriction treatment standards do not exist. Congress addressed this issue in 1992 with passage of the *Federal Facility Compliance Act of 1992* (FFCA). The FFCA required the Department to prepare site-specific treatment plans to address treatment of mixed waste to meet the land disposal restrictions at each facility at which DOE generates or stores mixed waste. To meet the requirement, site-specific treatment plans were developed, and through agreements or consent orders, commitments to schedules to treat or otherwise meet the land disposal restrictions were made. In accordance with the *WIPP Land Withdrawal Act of 1992*, as amended, transuranic mixed waste that is to be disposed at the Waste Isolation Pilot Plant (WIPP) is exempt from having to comply with the treatment standards and is not subject to the land disposal restrictions of 40 CFR Part 268. Therefore, management of most of the transuranic waste addressed in the agreements or consent orders is predicated on the assumption that mixed transuranic waste will be disposed at WIPP without treatment. Waste that is not eligible for disposal at WIPP, i.e., waste that cannot meet the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, must comply with RCRA treatment and disposal requirements, the *Federal Facility Compliance Act of 1992*, and consent orders and agreements with the States or EPA. This highlights the importance of avoiding actions in generating or managing waste that result in a waste not being acceptable for disposal at WIPP. Personnel should consult the site-specific treatment plans and agreements or consent orders as part of the life-cycle planning performed in accordance with Waste Generation Planning (DOE M 435.1-1, Section III.H).

<u>PCB, Asbestos, and Other TSCA Wastes</u>. Transuranic wastes contaminated with PCBs do not meet the definition of mixed waste, however, the situation is similar to RCRA in that there are

external requirements promulgated under the authority of the *Toxic Substances Control Act* that need to be complied with in addition to the requirements of DOE O 435.1 and DOE M 435.1-1. Waste managers responsible for managing PCB-containing products should consult the EPA requirements at 40 CFR Part 761. The regulations impose requirements for the destruction, storage awaiting destruction, and disposal of PCBs. Unlike mixed wastes, there are no provisions to accommodate PCBs (exceeding 50 ppm) at WIPP. If transuranic waste contaminated with PCBs cannot be treated to reduce the PCB concentration to less than 50 ppm, then it is one of the wastes that currently has no path to disposal (see General Requirements, Section I.2.F.(19)). Waste managers responsible for managing materials containing asbestos should consult the EPA requirements at 40 CFR Part 61, Subpart M. These regulations impose requirements for the removal of asbestos during demolition and renovation and disposal of asbestos-containing waste. This regulation includes cross-references to several other regulations governing management of asbestos that may also apply. Planning for management of transuranic wastes that include a component which is regulated under TSCA is addressed in the Complex-Wide Transuranic Waste Management Program and the appropriate Site-Wide Waste Management Programs (see DOE M 435.1-1, Sections I.2.B.(1) and I.2.F.(1)).

The DOE M 435.1-1 requirements imposed on the radioactive component of RCRA or TSCA waste should not create a duplication of management activities that can be satisfied by compliance with a RCRA or TSCA requirement. Also, documentation required by RCRA or TSCA requirements which provides the same or similar information as required by DOE M 435.1-1 can be used to satisfy the DOE M 435.1-1 requirement.

> *Example: Mixed transuranic waste is being sent from one site to another for storage. The Uniform Hazardous Waste Manifest is prepared as required by 40 CFR Part 262. It is determined that the manifest satisfies the need to document the transfer of ownership of the waste, the transfer date, and physical location of the waste. If the waste acceptance requirements of the facility receiving the waste allow it, the manifest may also provide the necessary information on the chemical and physical characteristics of the waste.*

Compliance with these requirements is demonstrated if RCRA, state-hazardous, and TSCA-regulated radioactive wastes are being managed in compliance with applicable requirements and agreements or in accordance with a consent order, and consistent with the Transuranic Waste Requirements of DOE M 435.1-1.

<u>Pre-1970 Transuranic Waste</u>. A definition for transuranic waste was first put into operational use by the Department's predecessor in 1970. At that time, the decision was made to store waste exceeding the transuranic waste limit. Waste disposed of prior to implementation of the 1970 Atomic Energy Commission Immediate Action Directive regarding retrievable storage of transuranic waste is not subject to the requirements of the *Radioactive Waste Management*

Manual. This interpretation is consistent with the decision of the Environmental Protection Agency as documented in the preamble to 40 CFR Part 191 (50 FR 38066). The Agency stated that the disposal standards do not apply to transuranic waste that already has been disposed of because the selection of disposal system site, design, and operational techniques are no longer available options. Therefore, "the Agency believes it appropriate that these disposal standards only apply to disposal occurring after the standards have been promulgated." Transuranic waste consists of waste generated by DOE activities that has been placed in retrievable storage since 1970, and waste that will continue to be generated as a result of plutonium stabilization and management activities, environmental restoration (including remediation of some sites where transuranic waste was previously buried), decontamination and decommissioning, waste management, and testing and research. Transuranic waste that was disposed of prior to 1970, retrieved as part of environmental restoration activities, may be managed in accordance with the requirements of the *Radioactive Waste Management Manual.*

Supplemental References:

1. EPA. 40 CFR Parts 260-270, U.S. Environmental Protection Agency, Washington, D.C.

2. EPA. *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*, 40 CFR Part 761, U.S. Environmental Protection Agency, Washington, DC.

3. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

4. EPA, 1996. *U.S. Environmental Protection Agency Catalog of Hazardous and Solid Waste Publications,* EPA530-B-96-007, U.S. Environmental Protection Agency, Washington, D.C., September 1996.

5. *Federal Facility Compliance Act of 1992*, as amended, October 6, 1992.

6. *Resource Conservation and Recovery Act of 1976*, as amended, October 21, 1986.

7. *Toxic Substances Control Act*, as amended, October 11, 1976.

8. EPA, 1973. *National Emission Standards for Hazardous Air Pollutants – National Emission Standard for Asbestos*, 40 CFR Part 61, Subpart M, U.S. Environmental Protection Agency, Washington, D.C., April 6, 1973.

9. AEC, 1970. *Policy Statement Regarding Solid Waste Burial*, Immediate Action Directive, IAD No. 0511-21, U.S. Atomic Energy Commission, Washington, D.C., March 20, 1970.

III. C. Complex-Wide Transuranic Waste Management Program.

A complex-wide program and plan shall be developed as described under *Responsibilities*, 2.B and 2.D, in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure the development, documentation, and implementation of a complex-wide transuranic waste management program. The complex-wide program and plan establishes the framework within which individual site programs operate.

Discussion:

The Department's management of transuranic waste occurs at over 15 sites that generate and store waste, as well as at the Waste Isolation Pilot Plant which is to serve as the central repository for most of the waste. A complex-wide program and plan establish the overall mission for the Department's management of transuranic waste and to provide a framework within which the individual site programs operate. The *Radioactive Waste Management Manual*, DOE M 435.1-1, Section I.2.B assigns the Assistant Secretary for Environmental Management the responsibility for developing and maintaining complex-wide, waste-type programs. The *Manual,* DOE M 435.1-1, Section I.2.D also assigns the Deputy Assistant Secretary for Waste Management the responsibility for developing and implementing complex-wide, waste-type program plans. The Complex-Wide Transuranic Waste Management Program and Plan are to be developed following the guidance provided for DOE M 435.1-1, Sections I.2.B and I.2.D.

Compliance with this requirement is demonstrated by the presence of a Complex-Wide Transuranic Waste Management Program which includes the appropriate interfaces, technical information, data inputs, and other elements described in Chapter I of this Manual.

Supplemental References:

1. CAO, 1997. *The National TRU Waste Management Plan,* Revision 1, DOE/NTP-96-1204, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, December 18, 1997.

III. D. <u>Radioactive Waste Management Basis</u>.

Transuranic waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

(4) Disposal Facilities. The performance assessment, disposal authorization statement, waste acceptance requirements, and monitoring plan.

Objective:

The objective of this requirement is to ensure that the hazards associated with transuranic waste management facilities, operations, and activities have been identified, their potential impacts analyzed, and appropriate controls documented, implemented, and maintained for the protection of workers, the public, and the environment.

Discussion:

As described in the guidance for DOE M 435.1-1, Section I.2.F.(2), the Manual requires the radioactive waste management basis to provide for development and documentation of controls to ensure the safe and efficient management of radioactive waste. Requiring an approved radioactive waste management basis for the initiation of new, or continuation of existing, radioactive waste management activities should prevent the operation of facilities without the appropriate controls. The required elements of the radioactive waste management basis vary with the type of waste management operation or facility and the types of hazards associated with the facility. The term "controls," used here and elsewhere in the discussion of a radioactive waste management basis, refers to processes, procedures, equipment, instruments, and other items intended to curb the likelihood of, or consequences from, a problem that could arise from managing radioactive waste. Controls include such things as placards, alarms, tools, shielding, training, checklists, duplication of critical steps, redundant monitoring, analysis, sampling and testing, etc. The items required for a radioactive waste management basis listed above for the four types of transuranic waste management facilities, operations, and activities is not a complete list of those items which should

be included in a radioactive waste management basis. Several processes, procedures, and documents that are required by other directives and requirements provide for radioactive waste management controls that should be considered part of the radioactive waste management basis. The guidance on DOE M 435.1-1, Section I.2.F.(2) discusses this aspect of the radioactive waste management basis in detail.

> *Example: Site X has a transuranic waste storage facility in which they store waste to be shipped to the Waste Isolation Pilot Plant. The Field Element Manager is responsible for ensuring that it operates in accordance with an approved radioactive waste management basis. The DOE staff reviews the waste acceptance requirements, the storage facility's waste certification program, plus the facility-specific procedures implementing the site's radiological control program, health and safety plan, training program, quality assurance program, and record-keeping plan. Based on the staff's review, they report to the Field Element Manager that an adequate radioactive waste management basis has been developed and recommend approval.*

Also, as discussed in the Section I.2.F.(2) guidance, if a transuranic waste management facility already operates under an approved Authorization Basis, it may not need any additional controls to demonstrate that it has a radioactive waste management basis. In this case, the Authorization Basis documentation is reviewed and evaluated to determine whether it sufficiently covers the requirements needed for a radioactive waste management basis. The Field Element Manager has the responsibility to ensure the transuranic waste management facilities under his or her authority have a radioactive waste management basis.

> *Example: Site personnel are developing the radioactive waste management basis for the Site Q Transuranic Waste Management Facility which provides non-destructive characterization, selected treatment and repackaging, and storage capabilities for transuranic waste. The site personnel identify the following documents and programs which include descriptions of the controls for safely managing waste at the facility:*
>
> - *Radiological Control Program*
> - *Site Health and Safety Plan*
> - *Safety Analysis Report (SAR)*
> - *Operational Safety Requirements/Technical Safety Requirements*
> - *Basis for Interim Operations*
> - *Technical Standards*
> - *Unreviewed Safety Questions Evaluation*
> - *DOE Safety Evaluation Report*
> - *Listing of documents that are to be Configuration Managed but are not Authorization Basis Documents (including the waste acceptance criteria and certification program documents).*

Following an analysis of the information contained in the above documents, the staff concludes that the complete set of operational requirements relied on by the site to ensure that the public, workers, and the environment are protected from hazards associated with management of transuranic waste at the facility are in place. A statement is prepared that documents that the radioactive waste management basis is covered by the Authorization Basis for the facility.

For a facility that generates transuranic waste, the radioactive waste management basis is to include the program for certifying that waste meets the waste acceptance requirements of the facility(ies) to which the waste will be sent. The waste certification program is reviewed against the applicable requirements of DOE M 435.1-1 and approved in accordance with the Radioactive Waste Generator Requirements (DOE M 435.1-1, Section I.2.F.(7)) before becoming part of the radioactive waste management basis. As discussed in guidance on DOE M 435.1-1, Section I.2.F.(2), several other processes and procedures contribute to a complete radioactive waste management basis at a generating facility.

Example: A small laboratory facility at Site R generates transuranic waste. The radioactive waste management basis for the facility is established through review and approval of the laboratory's waste certification procedure, and a review confirming the adequacy of the following: the Radiological Control Program, the Health and Safety Plan, the Training Program, and the site waste transfer procedure. This is documented in a radioactive waste management basis statement for the laboratory.

Facilities that store or treat transuranic waste are to have approved waste acceptance requirements (see DOE M 435.1-1, Section III.G) prior to the issuance of a radioactive waste management basis. The waste acceptance requirements will usually suffice as documentation of the radiological, physical, and chemical limitations on waste that can be safely received at the facility, provided they are developed correctly with consideration of the hazards of the waste to be managed, and are kept up to date. Controls on the radiological, physical and chemical limitations need to include considerations of the potential effects of radiolysis.

A facility that stores or treats waste is generally expected to have a waste certification program. Waste from these facilities will have to be certified as meeting the waste acceptance requirements of the facility to which it will be transferred and the facilities have the potential for generating radioactive waste (e.g., secondary processing streams from treatment, monitoring and sampling, radioactive release cleanup). Consequently, storage and treatment facilities should also have an approved waste certification program as part of their radioactive waste management basis. An exception to the need for a waste certification program can be justified based on there being no known path to disposal for the waste or based on the expectation that a long time will elapse

requirements (if regulations similar to those for WIPP certification are promulgated) or a process imposed by the Department.

Staff responsible for establishing a disposal facility radioactive waste management basis should combine the results of the review of the performance assessment (and compliance certification application if applicable) with their own findings on the waste acceptance requirements and monitoring plans as the basis for documenting the radioactive waste management basis for the disposal facility. Guidance for DOE M 435.1-1 Sections III.G (waste acceptance requirements) and III.Q (monitoring) provides details on what information needs to be addressed to meet the requirements and serve as part of the radioactive waste management basis.

For transuranic waste disposal facilities other than WIPP, a disposal authorization statement is to be issued by Headquarters following the review and approval of the performance assessment as required by DOE M 435.1-1, Section I.2.E.(1). The Waste Isolation Pilot Plant met the requirement for a disposal authorization statement when the Secretary of Energy provided notification to Congress that the Department of Energy would open WIPP for disposal operations pursuant to section 7(b)(3) of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended. In the notification, the Secretary determined that the Waste Isolation Pilot Plant was in compliance with all requirements of section 9(a)(1) of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended.

Contents of a Disposal Authorization Statement. The disposal authorization statement will clearly indicate the transuranic waste disposal facility and design that is being authorized to operate. The statement will refer to the performance assessment reviewed as the basis for the authorization and state the primary features of the disposal facility important for understanding the authorization of operations of the facility. Conditions and limitations for operations of the facility are clearly indicated in the disposal authorization statement. These include quantities, limitations, references, or codification of assumptions contained in the performance assessment. The conditions include any limitations or allowances required based on independent analysis of the disposal configuration and conditions being examined in the evaluations. The conditions also include any other limitations, responsibilities, or commitments that were needed to resolve issues during the review of the performance assessment or which will serve to answer questions that need to be resolved during the first years of operation of the disposal facility.

As part of the radioactive waste management basis, site personnel should implement a system or process for tracking the waste inventory at a storage, treatment, or disposal facility. Tracking the waste inventory is a means of ensuring that radionuclide limits established in accordance with a safety analysis or performance assessment will not be exceeded. In addition, a system or process for accurately tracking waste received at a facility can facilitate providing information to the complex-wide management data system (see guidance Section I.2.D.(2)).

Compliance with this requirement is demonstrated if, the radioactive waste management basis is documented and signed by the Field Element manager or a designee (see DOE M 435.1-1, Section I.1.A, Delegation of Authority) for each transuranic waste management facility, operation, or activity. Using a graded approach, it may be possible to include multiple activities under a single radioactive waste management basis, but it should be possible to objectively identify which activities are covered. Further, the radioactive waste management basis includes or references the controls that are established on a facility-specific basis to address the unique waste management requirements and circumstances for each facility, operation, and/or activity.

> *Example: A storage facility that stores mixed and non-mixed transuranic waste has approved waste acceptance requirements and a waste certification program that enables transuranic waste to be shipped to the Waste Isolation Pilot Plant for disposal. The mixed transuranic waste is to remain in storage pending WIPP receiving a RCRA Part B permit. The radioactive waste management basis statement references the waste certification process and the waste acceptance requirement documentation, which in turn invoke the waste acceptance requirements of WIPP. In addition to citing site-wide programs and plans (radiological control, health and safety, training, etc.) the radioactive waste management basis statement also cites the RCRA permit issued for storage of mixed transuranic waste and the facility operating procedure for segregating mixed and non-mixed waste within the facility.*

Supplemental References:

1. EPA. *Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*, 40 CFR Part 191, U.S. Environmental Protection Agency, Washington D.C.

2. EPA. *Criteria for the Certification or Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations*, 40 CFR Part 194, U.S. Environmental Protection Agency, Washington, D.C.

3. DOE, 1992. *Nuclear Safety Analysis Reports,* DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

III. E. Contingency Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving liquid transuranic waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of liquid contained in any one storage tank or treatment facility. Tanks or other facilities that are designated transuranic waste contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of liquid waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Objective:

The objective of this requirement is to ensure the impacts on the public, workers, or environment are mitigated in the event that a leak develops in a tank storing transuranic waste or in a facility processing transuranic waste. The mitigation is provided by ensuring spare waste storage capacity is a required part of a site's emergency management program. To meet this objective, there needs to be both capacity to handle the largest volume of any single storage tank or liquid waste in process, and the capability to transfer the waste.

Discussion:

This requirement shall be implemented through and included in site emergency management programs that are required by DOE O 151.1, *Comprehensive Emergency Management System.* The directive DOE O 151.1 is referenced in DOE M 435.1-1, Chapter I and considered necessary for the safe management of radioactive waste. The Comprehensive Emergency Management System requires the development of a complex-wide system for preparing for and managing emergencies. At the site level, personnel are to establish an Operational Emergency Base Program that provides the framework for responding to events involving, among other subjects, health and safety, and the environment. The program requires a qualitative hazards survey to identify the emergency conditions, describe the potential impacts, and summarize the planning and preparedness requirements that apply.

During the development of the requirements of DOE M 435.1-1, *Radioactive Waste Management Manual*, a waste management hazard and safety analysis identified the loss of containment of a storage tank or waste processing facility containing radioactive liquids as a hazard requiring mitigation. In addition to requiring facility designs to maintain waste confinement (see DOE M 435.1, Section III.M.(2)), the ability to respond to leaks or other off-normal conditions if they occur was also considered necessary. Consequently, the requirements to have adequate spare capacity and the ability to transfer waste to the spare capacity were established.

Operating procedures are developed and utilized for transfer of liquid transuranic waste to contingency storage. The procedures should address maximum operational capacities and limits for components of the operational system (e.g., spare storage capacity available in tanks). The procedures should define and address all possible emergency transfer scenarios needed to comply with this requirement.

<u>Contingency Storage</u>. Contingency storage is to be provided for both stored liquid transuranic waste and for liquid transuranic waste treatment facilities. In the case of storage tanks, adequate volumetric capacity must be available to receive the largest volume of waste stored in any single tank. In the case of a treatment facility, adequate volumetric capacity must be available to allow all in-process liquids in the facility to be moved into storage in the event of emergency or off-normal conditions.

A number of factors are considered in maintaining spare capacity. First, the requirement includes a provision that the spare capacity has "adequate capabilities." Therefore, the spare capacity must have the necessary features and functionality as dictated by the design and safety analysis for the facility and wastes of concern. Features to be taken into account include appropriate materials of construction, shielding, ventilation and filtration, heat dissipation, liquid level monitoring, and mixing. Similarly, if the waste that may need to be transferred is regulated by some external regulation (e.g., RCRA), the tank(s) that would be used for spare capacity should be properly permitted.

The requirement specifies that the contingency storage provided is to meet the requirements of DOE O 435.1 and DOE M 435.1-1. Of prime interest is the ability of contingency storage and associated facilities to meet the requirements for confinement in Facility Design, DOE M 435.1-1, Section III.M.(2). Additionally, compliance with the requirements for instrumentation and control systems, ventilation, and monitoring systems is very important for tanks or facilities that will be used for contingency storage. Meeting these requirements, in combination, ensures that the use of existing tanks or other facilities for contingency storage minimizes the potential impacts of off-normal or emergency situations involving liquid transuranic waste.

Spare capacity may be provided by a single tank or by the combined available volume in multiple tanks. In cases where radiation fields are sufficiently low, spare capacity could be provided by

portable tanks, tankers (i.e,. railroad cars), or tank trucks. Due to the potential for airborne radioactive material, impoundments or bermed areas open to the air should not be used for spare storage capacity unless a safety analysis shows that the risk to workers and the public is low.

Example: Liquid radioactive waste is stored in six underground storage tanks with a design capacity of 250,000 gallons each. The waste in the all tanks has the same chemical and radiological characteristics. One tank contains 200,000 gallons and each of the others contain about 100,000 gallons. Capabilities exist to retrieve waste and transfer it among the six tanks. This system meets the requirement because the largest volume of 200,000 gallons can be distributed between any two of the other tanks.

Transfer Equipment. The ability to perform the transfer is just as important as having the capacity. Equipment necessary to transfer each tank or treatment facility volume of liquid transuranic waste in the event of a leak or other off-normal condition is to be identified and documented.

Example: Liquid radioactive waste is stored in six underground tanks with the volumes and characteristics described in the previous example. Although there are transfer lines to any of the tanks from a central diversion box, the tanks were constructed without the capability to retrieve the waste. This situation does not comply with the requirement. Although there is adequate capacity, the ability to transfer the waste does not exist.

In addition, equipment necessary to transfer the contents of each tank is tested and inspected as part of a routine maintenance program (see DOE M 435.1-1, I.1.E.(9)). Special attention should be given to including in the maintenance program equipment and transfer lines that are not routinely used in managing liquid wastes. Inspection and testing includes the following minimum items:

- leak testing of pipelines;
- ensuring the availability of any jumpers necessary for completing waste transfer;
- confirming that instrument panels, control panels, valves, pumps and any necessary ventilation equipment is supplied with the necessary electrical power, air (for pneumatically-controlled items), steam, and water; and
- performing functional tests of instruments, controls, valves, pumps, and ventilation equipment.

The capability to perform an emergency transfer of liquid transuranic waste is to be maintained at all times. Therefore, every shift must include or have immediate access to qualified individuals

and the equipment necessary to perform transfers in a timely manner, unless analysis of the hazards associated with the leaking waste demonstrates that immediate transfer is unnecessary.

> *Example: A large shielding block is in place over a jumper pit that needs to be accessed during an emergency transfer of liquid waste. The block can only be moved by a crane. Therefore, implementation of this requirement entails making sure that the crane is always operationally available (in a matter of hours rather than days) and every shift has a individual qualified to operate the crane and remove the block.*

Spare capacity may be shared by different waste types, however mixing radioactive wastes of different types should be evaluated and is generally not acceptable.

> *Example 1: A tank farm contains both high activity liquid low-level waste and liquid transuranic waste in separate tanks. A spare empty tank is maintained and available for emergency transfers of either waste.*

> *Example 2: A tank farm contains both high-level waste and liquid transuranic waste in separate tanks. If the spare capacity were provided by excess capacity in tanks that contain high-level waste, use of the capacity for transuranic waste would be undesirable. Transferring transuranic waste into a tank containing high-level waste, would result in a mixture that would no longer be eligible for disposal at the Waste Isolation Pilot Plant which, by law, cannot dispose of high-level waste. Therefore, waste managers should identify different spare capacity to accommodate the two different waste* types.

Compliance with these requirements is demonstrated by having adequate spare capacity and transfer equipment exists for emergency transfers of all liquid transuranic waste. In addition, the capability to perform emergency transfers is demonstrated by having waste transfer routings identified, operational procedures to direct transfers, staff trained to the procedures, and records showing that the spare capacity and transfer capability are kept in operating condition.

Supplemental References:

1. DOE, 1995. *Comprehensive Emergency Management System,* DOE O 151.1, U.S. Department of Energy, Washington, D.C., September 25, 1995.

III. F. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

Objective:

The objective of this requirement is to ensure that actions will be taken to preclude, minimize, or mitigate hazards whenever a situation arises at a transuranic waste management facility that could threaten worker or public safety, or the environment.

Discussions:

The *Radioactive Waste Management Manual*, DOE M 435.1-1, Section I.2.G, states that all personnel have a responsibility to identify conditions that require corrective actions to achieve compliance with the Order and Manual requirements or to address health and safety conditions that pose an imminent or possible danger. That responsibility is to ensure that conditions that pose an imminent or potential danger to the environment, or to the health and safety of workers or the public are identified and corrected. If necessary, activities are to be curtailed or shutdown to ensure that the public, workers, and the environment are protected until corrective actions are implemented to mitigate the identified hazard.

Corrective actions are activities which, when implemented, will address and correct noncompliant or hazardous conditions. Corrective actions can include improvements to documentation (e.g., procedures, plans, authorization basis documents), training and qualification programs or procedures, physical and process design changes, changes to operating conditions, or a combination of these activities.

Corrective Action System. A corrective action system exists for addressing noncompliant or hazardous conditions for transuranic waste management facilities, operations, and activities. The system for addressing corrective actions may be an integral portion of the site's quality assurance program. Corrective actions in response to quality assurance program assessments are addressed in the *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120 and DOE O 414.1 Quality Assurance*. The corrective action system provides for documenting noncompliant or hazardous conditions, identifying the organizations or individuals responsible for developing and implementing corrective action plans, providing corrective action status, and tracking progress through final implementation of the actions. The corrective action system is instituted as a fundamental part of the systematic

evaluation of radioactive waste activities that is implemented by the Site-Wide Radioactive Waste Management Program (see guidance for DOE M 435.1-1, Section I.2.F.(1)).
A problem requiring corrective action could range from a minor deviation from a procedure that has minimal safety or public health implications, to a situation that poses an immediate threat to health and safety from an uncontrolled release of large quantities of radioactive material. For situations where a problem could pose an immediate risk to a worker, member of the public, or damage to the environment, immediate shutdown of the process or facility may be appropriate as the first step in addressing the problem (see guidance for DOE M 435.1-1, Section III.F.(2).

> *Example: An employee performing a routine container inspection in a storage facility notices that there are drums in an area designated for "WIPP-ready packages" that do not have a tamper indicating device on the container closure. The worker records his observation in the inspection log and notifies the building manager. The manager directs that a corrective action plan be prepared. The plan includes an evaluation of the conditions that resulted in the package being improperly controlled and recommends changes in procedures and training to the new procedures to prevent any recurrences. A notice is sent to staff responsible for receiving and handling waste containers and to generator organizations reiterating the requirement for tamper indicating devices. In addition, a follow-up review is schedule for 60 days after the plan is approved.*

If a facility or activity can be allowed to operate while a noncompliant or hazardous condition exists, the allowance and any associated limitations must be defined as part of the facility's or activity's radioactive waste management basis, identified as a configuration controlled item in a configuration management plan or included in a revision or modification to an operating procedure or similar controlled documentation. The corrective action system should provide for preventing the use of systems or facilities (e.g., through lockout), or procedures (through cancellation) in cases where it is determined that use of the system, facility, or procedure impacts safety.

> *Example: In the above example, the facility manager imposes a 2 week moratorium on receiving additional transuranic waste at the facility or certifying transuranic waste as meeting the Waste Acceptance Criteria for the Waste Isolation Pilot Plant. The manager expects that during the two week time period, the underlying problem can be identified and interim measures implemented to prevent a recurrence until the corrective action plan is fully implemented.*

Compliance with this requirement is demonstrated if a corrective action system exists which addresses noncompliant or hazardous situations associated with transuranic waste management and in a systematic fashion, and allows identification of problems by all personnel.

Supplemental References:

1. DOE, 1996. *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.120 and DOE O 414.1 Quality Assurance*, DOE G 414.1-1, U.S. Department of Energy, Washington D.C., August 1996.

III. F.(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Objective:

The objective of this requirement is to limit the operation of waste management activities and facilities as necessary to avoid creation of near- or long-term safety or environmental hazards.

Discussion:

The *Radioactive Waste Management Manual,* DOE M 435.1-1, requires that a radioactive waste management basis be established for each transuranic waste management facility, operation, or activity. The radioactive waste management basis documents the conclusion that the potential hazards from management of radioactive waste have been sufficiently evaluated and that adequate controls are in place to provide assurance that the public, workers, and the environment are being protected. Field Element Managers are responsible for ensuring a radioactive waste management basis is developed, reviewed, approved, and maintained for each DOE radioactive waste management facility, operation, or activity (DOE M 435.1-1, Section I.2.F.(2)). The guidance for that requirement should be consulted for additional details on the development, review, and approval of a radioactive waste management basis. Also, additional discussion concerning the radioactive waste management basis for transuranic waste generator, treatment, storage, and disposal facilities is discussed under guidance for DOE M 435.1-1, Section III.D.

As part of his/her responsibilities for maintaining the radioactive waste management basis for transuranic waste management facilities, operations, and activities under his/her authority, the Field Element Manager evaluates the compliance of the facilities, operations, and activities with the constraints and controls documented in the radioactive waste management basis by ensuring that routine assessments are conducted. If the Field Element Manager determines, either through routine assessment or by virtue of an occurrence or off normal event, that an operation, activity, or facility is not operating in compliance with an approved radioactive waste management basis, it must be curtailed or shut down. The action taken is commensurate with the hazards associated with the noncompliance and with the continued operation of the facility.

This requirement is to be implemented in a graded manner. Actions to be taken are based on assessments of adherence to radioactive waste management bases, and can range from shutdown of an operation or facility to placing limits or constraints on what activities can be performed or how the activities are to be performed. Shutdown of a facility involves stopping all operations in the facility except surveillance or monitoring activities necessary to maintain the facility in a safe standby condition. Shutdown is considered appropriate when there is either a potential imminent threat to safety or environmental protection, or a blatant failure to establish or comply with a radioactive waste management basis.

Alternatively, there may be cases where a facility, operation, or activity assessment determines that the radioactive waste management basis is no longer current or has been violated, but there is no imminent threat to public, worker, or environmental protection. In such a case, the Field Element Manager may decide that shutdown of the facility is not necessary. It may be sufficient to impose certain limits until the radioactive waste management basis is made current. The limits imposed may prohibit the generation, receipt, or processing of certain waste streams, or may involve constraints on the processes that may be performed.

The action taken in response to the failure to establish a radioactive waste management basis is to be clearly documented in a formal communication (e.g., letter, memorandum). Such communication needs to identify the reason for the shutdown or curtailment, and identify what is necessary to initiate restart. Generally, development of a corrective action that is implemented through the corrective action system discussed in the preceding section would be appropriate for responding to a shutdown or curtailment of activities.

In concert with Core Requirement #6 of the Integrated Safety Management System, "Feedback and Improvement," the Field Element Manager should use the audits and assessments to identify opportunities for improvement in the implementation of an activity or facility's radioactive waste management basis. Identified improvement actions should be shared with like organizations and tracked by management to determine whether they are yielding the anticipated improvements. Communicating the results of assessment upward in the DOE and contractor organization will allow the findings to reach the management level with the authority necessary to effect improvements.

Compliance with this requirement is demonstrated by documented evidence of systematic, routine reviews to determine whether waste management activities and facilities under are operating in accordance with an approved radioactive waste management basis. In addition, the documentation should show that limitations (which may include shutdown) have been placed on activities and operations that do not have or are operating outside the conditions of an approved radioactive waste management basis.

Supplemental References:

1. DOE, 1996. *Safety Management System Policy*, DOE P 450.4, U.S. Department of Energy, Washington, D.C. October 15, 1996.

2. DOE, 1997. *Line Environment, Safety and Health Oversight*, DOE P 450.5, U.S. Department of Energy, Washington, D.C., June 26, 1997.

3. DOE, 1997. *Safety Management Functions, Responsibilities, and Authorities Policy*, DOE P 411.1, U.S. Department of Energy, Washington, D.C., January 1, 1997.

4. DOE, 1997. *Manual of Safety Management Functions, Responsibilities, and Authorities*, DOE M 411.1-1, U.S. Department of Energy, Washington, D.C., October 8, 1997.

III. G. Waste Acceptance.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all transuranic waste storage, treatment, or disposal facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides;

(b) Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal;

(c) Restrictions or prohibitions on waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance;

(d) Requirement to identify transuranic waste as defense or non-defense, and limitations on acceptance; and

(e) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements, which shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved.

Objective:

The objectives of the waste acceptance requirements are to ensure that transuranic waste which is received at a facility contains only the radionuclides that the facility can safely manage, and only in concentrations and/or total activities which are compatible with the work to be undertaken in the facility; ensure that transuranic waste which is to be received at a facility is in a form or package that will maintain its integrity and retain acceptable configuration under the conditions that are expected to be encountered during the management steps the waste will undergo; ensure that no transuranic waste received at a facility contains materials that will compromise the safety or integrity of the facility under the expected operating conditions; and ensure that formal procedures exist and a decision process is clear concerning the granting of exceptions to waste acceptance requirements.

Discussion:

As discussed in the guidance for DOE M 435.1-1, Section I.2.F.(6), the waste acceptance requirements establish the conditions for waste that facilities can safely receive. Therefore, the acceptance requirements for a transuranic waste storage, treatment, or disposal facility include all requirements that transuranic waste must meet to be acceptable for receipt, and for the subsequent storage, treatment, or disposal, as appropriate.

In conducting the analyses for development of the DOE M 435.1-1 requirements, minimum acceptance requirements that must be specified in the waste acceptance documentation for storage, treatment, and disposal facilities in order for transuranic waste to be safely handled were identified. Guidance on subrequirement (a) is provided below under Radionuclide Content or Concentration. Guidance on subrequirements (b) and (c) is provided under Waste Form and Package Criteria and Prohibitions. Guidance on subrequirement (d) is provided under Defense/Non-Defense Waste. Guidance on subrequirement (e) is provided under Exceptions.

Development of Waste Acceptance Requirements. A facility receiving waste for storage, treatment, or disposal is required to document the waste acceptance requirements for the facility. These requirements have their foundation in facility design capabilities such as volume, handling weight, allowable contents, and radiological limits (i.e., criticality, radiation, contamination). Other requirements may include any number of regulations promulgated by the EPA, NRC, DOT, the host state, and DOE itself. The designer and operator of the facility receiving waste are likely to be most knowledgeable and understanding of the requirements and limitations of the facility and, therefore, are in the best position to establish the waste acceptance requirements or criteria that must be met for waste sent to the facility.

Although there are exceptions, most transuranic waste in the Department is to be disposed at WIPP. The exceptions include waste that cannot meet the waste acceptance criteria of WIPP or are otherwise ineligible (e.g., non-defense waste). Personnel responsible for transuranic waste storage or treatment facilities which manage waste destined for WIPP need to consider the WIPP waste acceptance criteria in developing acceptance criteria for their facilities.

A transuranic waste management facility at a site may have its own specific stand-alone waste acceptance requirements. Or a site may have general waste acceptance requirements applicable to all transuranic waste management facilities at the site, with separate facilities adding facility-specific acceptance requirements to the site waste acceptance requirements as necessary. This practice may be particularly effective at sites with many facilities which manage small quantities of waste with multiple locations for staging, storage, and/or central management of waste. At such facilities, most of the process and procedural waste acceptance requirements could be in one document applicable to the whole site, which would be supplemented with specific technical requirements for acceptance at each of the separate management locations. If activities across

various facilities are similar, they could share the same supplemental waste acceptance requirements documents. Likewise, if several activities are carried out at locations that are close to one another, or are managed by the same entity, then one supplemental technical document may be prepared to cover those activities.

The waste acceptance requirements and documentation for a facility receiving waste for storage, treatment, or disposal is prepared using a graded approach commensurate with the hazards associated with the management of the waste in the facility and the complexity of the activities to be conducted in the facility. The waste acceptance requirements for a facility which receives large quantities of transuranic waste from many generators, or with highly variable contents, or both, may need to address many hazards and consequently be more detailed. By contrast, a storage facility which will only pass-through properly packaged waste directly to a disposal facility without any additional processing or packaging may only need a minimal set of requirements. Perhaps only a few administrative requirements would be necessary for proper receipt of waste at such a storage facility, along with assurance that waste received at the storage facility meets the disposal facility technical waste acceptance requirements.

Example 1: The Waste Isolation Pilot Plant is to receive defense transuranic waste generated by many different processes and from many different sites. In addition, the transportation of contact-handled transuranic waste to WIPP is to be in TRUPACT II containers. The requirements for acceptance of waste at WIPP are extensive and require a high degree of rigor. The waste acceptance requirements are addressed in a number of interrelated documents. These documents include the Waste Acceptance Criteria for the Waste Isolation Pilot Plant, the Generator Site Certification Guide, the Quality Assurance Program Description, and the Transuranic Waste Characterization Quality Assurance Program Plan.

Example 2: At a DOE site, several facilities are used for storage of transuranic waste. A single waste acceptance requirements document which contains the necessary administrative requirements for all of the storage facilities is prepared as an umbrella document at the site. For each storage facility, a supplemental technical procedure which contains the technical criteria specific to the facility (e.g., inventory limits based on safety evaluations) and which invokes the umbrella document for the administrative processes and forms is prepared. This combination of documents provides the necessary waste acceptance criteria for waste to be received at the facilities.

Legislation, regulations, performance assessments, safety analysis reports, technical safety requirements, criticality analyses, and other appropriate safety or authorization basis documents are to be used to establish the waste acceptance criteria for facilities receiving transuranic waste for storage, treatment, or disposal. These documents and analyses provide the basis for radioactivity (concentration and inventory) limits, waste categories (e.g., contact-handled or

remote-handled), waste form and/or packaging stability requirements, allowable chemical content, allowable free liquid content, and any other necessary waste package or form requirements to ensure that the facilities' design, performance, and operating bases are not compromised.

Radionuclide Content or Concentration. Radiological limits for storage, treatment, and disposal facilities may be derived from a number of technical as well as administrative sources. In developing radionuclide limits, personnel need to consider legislative and/or regulatory limitations, the disposal facility performance assessment, safety analysis reports, and criticality analyses. In addition to establishing general radiological limits (e.g., a contact dose rate), these sources identify specific radionuclides whose concentration or total activity must be limited in the waste acceptance criteria in order to remain within the bounds for safe and legal facility operation.

The operating definition of transuranic waste is taken from Federal legislation (see guidance for DOE M 435.1-1, Section III.A). The definition is significant to transuranic waste management because the designated disposal facility for defense transuranic waste, WIPP can only accept waste that meets that definition. Storage and treatment facilities need to include appropriate waste acceptance requirements that require identification of transuranic waste to facilitate its eventual transfer for WIPP disposal.

The results of a long-term performance assessment analysis may provide information on critical radionuclides that are most important to the long-term performance of the disposal facility. The waste acceptance criteria for the disposal facility are to translate the results of the performance assessment analyses into limits on the receipt of waste at the facility or on the operation of the facility.

> *Example: The performance assessment of WIPP is based on an assumed final inventory of transuranic and other radionuclides. Although the performance assessment indicated that facility performance was not sensitive to radionuclide inventory, in the Compliance Certification Application WIPP committed to tracking the cumulative inventory of radionuclides of interest. Therefore, the waste acceptance criteria require sites to report the inventory or concentration of these radionuclides of interest.*

Although performance assessments are not required for storage or treatment facilities, personnel developing waste acceptance criteria for these types of facilities should consider the radiological limits of WIPP. In most cases, transuranic waste will eventually be transferred to WIPP for disposal, so WIPP waste acceptance criteria should be factored into the waste acceptance requirements of the storage or treatment facility to ensure a situation is not created in which the waste does not have a path to disposal.

> *Example: A transuranic storage facility accepts a high dose rate transuranic waste from a generator. Due to the dose rate, the waste is managed and stored as remote-handled*

waste. However, when placed into storage, the waste does not meet the WIPP waste acceptance criteria, thus creating a future management issue. As an alternative, the waste acceptance criteria could be revised to not allow acceptance of transuranic waste that does not meet the WIPP waste acceptance criteria. The generator would be compelled to work with the waste management organizations to determine how to manage or process the waste at the source in order to meet the disposal criteria of available facilities (transuranic and/or low-level waste).

The safety analysis report or safety evaluation prepared for a transuranic waste management facility may identify specific radionuclides that warrant specific attention from a worker safety standpoint, and may require special handling if received and managed at the facility.

Example: A storage facility that manages mixed transuranic waste is subject to RCRA Part B permit requirements for routine inspection of the waste. An analysis of worker radiation exposure associated with inspection of the storage configuration indicates that several radionuclides need to be controlled below certain concentrations to maintain doses to workers as low as reasonably achievable. The waste acceptance requirements for the facility reflect the allowable concentrations from the safety analyses as maxima for waste that can be accepted for storage in the facility.

Any criticality analyses conducted in accordance with the criticality safety program in conformance with DOE M 435.1-1, Section I.1.E.(4) may also result in limitations on acceptance of fissile radionuclides. These limitations need to be included in the waste acceptance requirements, as appropriate. Similarly, for transuranic waste, the *TRUPACT II Safety Analysis Report for Packaging* establishes limits on the amount of fissile material that is allowed to be transported in the TRUPACT II. These limits need to be considered in the development of waste acceptance criteria to avoid the need to repackage waste to transfer it to the next step in the waste management process. These limits are reflected in the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant.*

Waste Form and Package Criteria and Prohibitions. Generally, waste acceptance requirements specify that wastes received at the facility are in a physically/chemically stable form. As used in this requirement, stability refers to the physical and chemical properties of waste that are necessary for it to be handled safely at a facility and to undergo the management steps normally performed at that facility. Such stability is dependent on the waste management steps to be performed with the waste (e.g., treat, store) and the time to complete the management step (e.g., time until treatment or length of expected storage period). Therefore, waste acceptance requirements must specify the physical and chemical stability that correspond to the specific operations and activities of a particular facility. Waste acceptance requirements for a transuranic waste treatment facility need to specify the physical and chemical precautions and conditions under which untreated waste can be received at the facility so that facility safety and effective

operations will not be compromised. Any physical or chemical stabilization of waste prior to transfer to a facility receiving waste for storage, treatment, or disposal needs to be done according to a systematic process that may include consideration of bench-scale testing and verification that the process is producing satisfactory results.

> *Example: A facility that is in the process of cleaning out transuranic radionuclide-contaminated glove boxes determines that operational efficiencies will be realized in the form of fewer drums, less storage space, and fewer transuranic waste shipments if they compact the cleanout waste into 55-gallon drums. The organization responsible for operating the compactor establish a set of waste acceptance criteria for waste that can be received from the cleanout activities. The criteria, based on expected ability to fit 25 boxes in a drum, specify: waste must be packages in 1 cubic foot cardboard boxes; no more than 5% of the volume of a box can be incompressible waste; the long axis of incompressible waste must be oriented in a horizontal plane; boxes must be free of removable external contamination; the dose rate from any box must be less than 10 mrem/hr; there must be less than 8 plutonium-239 fissile-gram equivalents per box; there must be less than 3 plutonium-239 equivalent curies per box; waste must be less than 50 ppm polychlorinated biphenyls, and the waste must be characterized for RCRA constituents. Based on these criteria, the compactor facility can provide 55-gallon drums that meet the on-site storage facility's requirements, and subsequently, the WIPP requirements.*

The waste acceptance requirements are to specify waste streams, classes, or categories of waste requiring application of specific physical, chemical, or structural stabilization methods, as determined by the results of safety analyses or long-term performance assessments. Acceptable waste forms, containers, and packages are specified by the waste acceptance requirements. The waste acceptance requirements need to list any specific packages and containers pre-approved as acceptable for the transuranic waste management facilities, as well as acceptable overpacks. The waste acceptance requirements need to identify any of the following specific technical requirements that must be included to ensure that waste received at any storage, treatment, or disposal facility is consistent with the operating basis of the facility:

- the acceptable limits for waste package external surface dose rate for both contact and remote handled packages;
- the acceptable limits for waste package surface contamination;
- the allowable heat generation rates;
- the acceptable limits for free liquid content, specified on a per package basis;

- the acceptable limits for maximum void space, specified on a per package basis;
- the necessary labeling and marking, including information about bar coding or other tracking system used at the facility receiving the waste and the application of the system by generators;
- any specific radionuclides or chemical or hazardous materials that are prohibited from acceptance at the facility. This may include pyrophoric materials, explosives, or materials that might cause violent reactions during storage, treatment, or disposal;
- any specific requirements associated with acceptance of mixed transuranic waste, including any additional restrictions or limitations on the waste or specifications for handling mixed waste containers;
- any specific requirements associated with acceptance of special transuranic waste needing out-of-the ordinary attention for receipt, handling, storage, treatment, or disposal, (e.g., sealed sources), including any additional restrictions or limitations on the waste or specifications for handling the waste containers;
- any package protection requirements needed for transport and receipt to provide needed physical protection of the packages to prevent breaching and so that the certified status of the waste is preserved; and
- the necessary shipping arrangements for transport to the facility receiving waste, including any electronic data bases or scheduling system used.

Example 1: Waste acceptance criteria for the Waste Isolation Pilot Plant have been developed based on applicable requirements, e.g., statutory requirements, other environmental compliance requirements, operational and safety analysis requirements, and transportation requirements. Development of waste acceptance requirements based on these sources ensures that waste received at WIPP complies with applicable regulations and can be safely managed at the site. The requirements include technical requirements addressing container properties, physical properties, nuclear properties, chemical properties, and gas generation; and administrative requirements for data that need to be provided with waste shipments.

Example 2: A transuranic waste containing spent solvents regulated by RCRA is transferred from a storage facility to a treatment facility for treatment. The treatment facility personnel must establish the limits, if any, on the concentration of solvents for which the treatment process was designed and qualified, and limitations or prohibitions

on other materials that may adversely affect the processing. The waste treatment process is to produce a treated waste product that (1) has been reduced in transuranic contaminant concentrations such that it may be disposed of as mixed low-level waste or (2) is acceptable for disposal at the WIPP as mixed transuranic waste. In either case, the final treated waste form must also meet the disposal facility waste acceptance criteria. In order to ensure that the treatment process product will meet applicable requirements, the treatment facility must document the limitations in the waste acceptance criteria that the organization supplying the waste must meet. By doing so, the treatment facility can safely process the waste, treat it successfully, and produce a product that can be disposed of.

Defense/Non-Defense Waste. The *WIPP Land Withdrawal Act of 1992*, as amended, limits the waste that can be accepted for disposal at WIPP to transuranic waste generated by atomic energy defense activities. In order to ensure compliance with the statutory constraint, and to facilitate identification of waste that can be disposed of at WIPP, all transuranic waste acceptance criteria must include a requirement for waste to be identified as defense or non-defense. At a minimum, the waste acceptance criteria should require identification of waste as defense or non-defense to be part of the certification program (see Waste Certification guidance for DOE M 435.1-1, Section III.J) and be included in the documentation used to transfer responsibility to personnel at the facility receiving the waste for storage, treatment, or disposal. The requirement applies to all transuranic waste and to all waste management facilities to ensure that the defense or non-defense identity of waste is not lost during waste generation and subsequent processing operations.

Example: The waste acceptance criteria for a transuranic waste storage facility has a waste transfer form that is to be used for each transfer of waste to the facility. The form, which the waste acceptance criteria requires to be used to document the certification that waste meets the waste acceptance criteria, includes identification of the waste as defense or non-defense as a mandatory piece of data. In addition, the waste acceptance criteria require that waste packages be marked to indicate the waste as being defense or non-defense. The waste acceptance criteria identifies three acceptable means of marking waste packages, color of the package, labeling, or through bar coding.

The Departmental interpretation is that the term "atomic energy defense activities" used in the *WIPP Land Withdrawal Act of 1992*, as amended, has the same meaning as the same term used in the *Nuclear Waste Policy Act of 1982*, as amended.

The term "atomic energy defense activities" permits WIPP to dispose of defense transuranic waste resulting from all of the noncivilian activities and programs of DOE, including weapons production, naval reactors, defense research and development, associated defense environmental restoration and waste management and other defense-

related activities, as defined more specifically in the *Nuclear Waste Policy Act*, from which the term was borrowed. (Nordhaus, 1996)

As the *Nuclear Waste Policy Act of 1982*, as amended, states, the term "atomic energy defense activity" means any activity of the Secretary [of Energy] performed in whole or in part in carrying out any of the following functions:

(a) naval reactors development;
(b) weapons activities, including defense inertial confinement fusion;
(c) verification and control technology;
(d) defense nuclear materials production;
(e) defense nuclear waste and materials by-product management;
(f) defense nuclear materials security and safeguards and security investigations; and
(g) defense research and development.

This definition of atomic energy defense activity does not include transuranic waste generated from DOE's civilian atomic energy activities.

Exceptions. Waste acceptance requirements are established to ensure that facilities can safely manage waste received for storage, treatment, or disposal. Thus, exceptions or deviations to waste acceptance criteria cannot be routine and must be carefully reviewed and documented. The procedures for granting exceptions need to clearly state the entire process for requesting an exception, describe acceptable bases for granting exceptions, and identify any additional information that is needed to supplement the documentation normally provided for waste transfers. The approval process needs to be clearly spelled out including identification of the officials who have the authority to approve the exception.

Example: The waste acceptance requirements for a transuranic waste storage facility establishes a per package limit on fissile material. The limit was developed based on criticality and safety analyses which assumed all of the packages in the facility could potentially contain the specified amount of fissile material. A generator has a waste package that slightly exceeds the limit. The waste acceptance requirements specify the that the generator needs to identify the criterion for which an exception is being requested and provide relevant information about the waste package or waste stream for which an exception is being sought. It further identifies to whom the request for an exception is to be submitted. At the storage facility, there are documented procedures indicating the process to be followed for evaluating the exception request and identifying the facility manager as the approval authority. In this case, an analysis is performed indicating that because of the small inventory of fissile material in the facility, an exception can be granted. Documentation supporting this decision includes notification to the generator that the exception is granted, copies of the analyses performed to

support the decision, and additional controls on waste that can be accepted in the facility during the time the particular waste remains in storage (i.e., limits may have to be placed on the per package content of other waste or on the total number of packages that the facility could accept).

Compliance with these requirements is demonstrated if waste acceptance requirements are documented, contain clear and precise criteria specifying the radionuclide limits in the form of contents or concentrations that can be accepted, the limitations and prohibitions on waste forms and packages that can be received, and the limits, prohibitions, or instructions concerning any other technical information so that the waste is compatible with the safety basis of the facility, and which will result in acceptable waste at subsequent steps in managing the transuranic waste. Waste acceptance requirements are to also contain a clear description of the process and bases for obtaining an exception or deviation to the acceptance criteria for transuranic waste to be received at the facility.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, August 1997.

2. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

3. CAO, 1996. *Quality Assurance Program Document*, Revision 1, CAO-94-1012, U.S. Department of Energy, Carlsbad Area Office, Carlsbad NM, 1996.

4. CAO, 1998. *U.S. Department of Energy, Transuranic Waste Characterization Quality Assurance Program Plan,* Revision 1, CAO-94-1010, U.S. Department of Energy, Carlsbad Area Office, Carlsbad NM, December 18, 1998.

5. CAO, 1998. *TRUPACT-II Operating and Maintenance Instructions,* Revision 1, DOE/WIPP-93-1001, U.S. Department of Energy, Carlsbad Area Office, Carlsbad NM, May 1998.

6. Nordhaus, 1996. Robert R. Nordhaus, to Al Alm, memorandum, *Interpretation of the Term "Atomic Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, U.S. Department of Energy, Washington, D.C., September 9, 1996.

III. G.(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Objective:

The objective of this requirement is to establish a process by which personnel at a facility receiving transuranic waste for storage, treatment, or disposal determine that the waste being transferred is acceptable in accordance with the waste acceptance requirements, and for that process to specifically address management of waste that does not conform with all of the requirements when it is received at the facility.

Discussion:

This requirement makes it the responsibility of officials at a facility to which waste is transferred to confirm that waste is in compliance with the established waste acceptance requirements and also provides a mechanism by which the officials confirm that waste can be accepted and safely managed at the facility.

Evaluation and Acceptance. The methodology for implementing the evaluation and acceptance of transuranic waste needs to be flexible and defined on a facility-specific basis. The complete process and procedures, including the responsibilities of generating facilities, need to be clearly documented so that both the generator and the facility receiving the waste understand the process that will be used. As with implementation of other parts of DOE M 435.1-1, this requirement is implemented using the graded approach. Facilities receiving transuranic from many generators and/or offsite generators may need to implement more detailed waste evaluation and acceptance processes than a facility receiving waste from a small number of onsite generators.

The evaluation and confirmation process consists of one or more of the following approaches, and is designed to demonstrate that the waste presented meets the waste acceptance requirements of the facility receiving waste for storage, treatment, or disposal:

- Testing, sampling, and analysis of the contents of a representative sample of waste packages as they are received at the facility;
- Testing and analysis of a number of samples taken at the generator facility;
- Detailed review of sampling and analysis data generated by the sending facility or an independent laboratory employed by the generating facility;

- Audit, review, or surveillance of the sender's waste characterization activities and processes and waste certification programs.

Testing, sampling, and analysis of the contents of a representative sample of waste packages upon receipt is complicated by the fact that additional risk is posed if a technique such as opening of drums and obtaining grab samples is used. Therefore, consideration needs to be given to implementing non-destructive examination technologies if receipt sampling and analysis is the preferred approach. Likewise, analysis of samples taken at the generator's site may involve additional risk, and also may be expensive to implement. If this method is employed, samples which are representative, either statistically or correlated with generator profiles, need to be obtained for analysis to validate this method as accurate. This sampling would include packages from the generators sending the largest volume of waste to the facility or packages containing the critical radionuclides as identified in the waste acceptance requirements.

Example: The waste acceptance process for a storage facility that receives waste from multiple generators involves assay to confirm the waste is transuranic, and sample collection and analysis to confirm its RCRA status. The process calls for assaying and sampling one waste package of every 100 from established waste streams and one of every 10 for new waste streams or for waste streams from generators who have a history of poor compliance with the waste acceptance criteria.

The use of a detailed review of the sampling and analysis data gathered by others would include an evaluation of the methodologies used for collecting the sample, maintaining the integrity of the sample and data (e.g., through a chain of custody), and performing the radioanalyses. As above, the samples collected would need to be representative of the waste, either statistically or with a bias towards large generators or generators of significant radionuclides (i.e., those that are most limiting for the storage, treatment, or disposal facility).

The use of assessments (audits, reviews, or surveillances) to verify compliance of the waste generators' certification programs with acceptance requirements would need to be conducted on a regular schedule commensurate with the frequency of waste generation and shipments. The documentation of the verification process would include organization and authorities; frequency of assessments; methods to be employed; the information that will be documented as a result; and the qualifications of personnel.

Example: At the Waste Isolation Pilot Plant, there are no plans for sampling waste packages upon receipt. Instead, WIPP has instituted a program in which generator site waste certification programs are reviewed to determine whether they will produce waste packages meeting the waste acceptance criteria. A Generator Site Certification Guide describes what is entailed in obtaining an approved site certification program. Once a site has developed its program, representatives from WIPP evaluate it, and if determined

to be acceptable, approve it. After a site's certification program has been approved, WIPP personnel rely on the combination of site certification that waste packages comply with the site's approved program and their own review of transfer documentation and processes to assure that waste meets the waste acceptance criteria. Site certification programs are re-evaluated annually to confirm that they are still adequate.

Non-Conforming Waste. Facilities receiving waste for storage, treatment, or disposal must have a documented process to be used in the event a non-conforming waste is received. A non-conforming waste is a waste container or shipment which is certified by the generator as meeting the waste acceptance requirements of the receiving facility, but which is found to be in violation of the acceptance criteria during the facility's waste receipt and inspection process. Facility procedures need to address how non-conforming waste will be segregated from acceptable waste, the process for notifying the sender of the non-conformance, and the acceptable methods for dispositioning the non-conforming waste. The process includes prior notice to the sender of the actions to be taken by the facility receiving the waste and the sender's obligations, particularly regarding the cost of the actions, to support the disposition of the non-conforming waste.

Example: A transuranic waste storage facility's waste acceptance procedures require that non-conforming waste be segregated from conforming waste and isolated by a rope barrier pending resolution of the non-conformance. The procedures further require notification of the generator of the non-conformance and a resolution to be negotiated with the generator. The process requires consideration of risk and cost in determining the proper resolution.

Compliance with these requirements is demonstrated if there is a procedure or process for evaluating and accepting incoming waste which ensures the acceptance criteria of the facility receiving the waste are met by one or a combination of: (1) testing, sampling, and analysis of representative samples of incoming waste upon receipt; (2) testing, sampling, and analysis of samples of waste taken at the generator facility; (3) evaluation of testing, sampling, and analysis of data provided by the generator; or (4) audits, reviews, or surveillances of generator waste certification programs and characterization activities. Additionally, acceptable waste acceptance requirements for a storage, treatment, or disposal facility will have documented procedures and actions to be taken if a waste that does not conform to the waste acceptance criteria is received at the facility.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, August 1997.

2. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. H. Waste Generation Planning.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all transuranic waste streams.

Objective:

The objective of this requirement is to provide for the disposal of all transuranic waste that is generated in the future by ensuring that prior to generating a new transuranic waste stream, the specific waste management facilities necessary for safe management of the waste from the time it is generated up to and including its disposal are identified; plans are developed for resolving issues that prevent disposal, and for safe, long-term storage for transuranic waste with no path to disposal; and sites are discouraged from generating transuranic waste that does not have an identified path to disposal.

Discussion:

The Department intends on disposing of stored and future defense transuranic waste (the majority of DOE transuranic waste) that meets waste acceptance requirements at WIPP. The subject requirement is based on a recognition that protection of the public, workers, and the environment is best assured if transuranic waste is generated with cognizance of its final disposition and of the waste management facilities that are needed until the waste is disposed. In developing DOE O 435.1 and DOE M 435.1-1, the safety and hazards analysis identified long-term storage of waste, and potential loss of characterization data from generators and the subsequent need for recharacterization as weaknesses to be mitigated. Therefore, as part of the generator planning requirements in DOE M 435.1-1, Section I.2.F.(7), specific requirements are identified for planning the management of waste prior to its generation, and for approval to generate transuranic waste streams with no identified path to disposal.

Life cycle planning for all transuranic waste. Planning prior to generating transuranic waste is primarily intended to address newly-generated waste streams. Life-cycle planning for waste that has been generated and continues to be generated is documented through the Site-Wide Waste Management Program required in DOE M 435.1-1, Section I.2.F.(1). The following discussion describes the types of life cycle planning need. The information needed is influenced by the fact that, on the implementation date of the Order, the transuranic waste will be in one of three stages of its life-cycle: (1) waste generated in the past (in storage); (2) waste being generated at present; and (3) wastes not yet generated (future wastes); and will either have an identified path to disposal, or will not.

Therefore, from a waste generation planning perspective, there are six different "states" of transuranic waste, depending on when the waste was or is generated and whether it has or will have a path to disposal. The following paragraphs explain the recommended life cycle information for these different transuranic wastes.

Transuranic Waste With a Path to Disposal

Generated currently - The life-cycle information for currently generated transuranic waste with an identified path to disposal includes a description of the management steps for the waste as discussed in guidance for the Site-Wide Radioactive Waste Management Program.

Generated in the future (from a new process) - The life-cycle information for transuranic waste with an identified path to disposal that is generated from a new process includes a description of the management steps for the waste as discussed in guidance for the Site-Wide Radioactive Waste Management Program.

Generated in the past (in storage) - In addition to the basic information on management steps, life cycle information for transuranic waste with a path to disposal that is in storage (due to budget constraints, delays due to regulatory matters or management decisions, or for other reasons) includes a schedule for achieving disposal. For transuranic waste in earthen-covered storage, the retrieval plan required by the storage requirements (DOE M 435.1-1, Section III.N) can be used to meet this requirement provided it has a schedule.

Transuranic Waste Without a Path to Disposal

Generated in the past (in storage) - The life-cycle information for transuranic waste in storage as of the issuance of DOE O 435.1 for which there is not an identified path to disposal includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues.

Generated in the future (from a new process) - The life-cycle information for transuranic waste without an identified path to disposal which is generated from a new process includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues. This information will be assembled in the course of getting the generation of the waste approved in accordance with the process required in DOE M 435.1-1, Section I.2.F.(19), and is also discussed in the next section of this guidance.

Generated currently - The life-cycle information for transuranic waste without an identified path to disposal includes the basic information on the management steps for the waste which can be identified, a discussion of the issues that hinder disposal of the waste, and the plans and schedule for achieving resolution of the issues. The intent of the requirement is not to ensure that these waste streams receive approval for generation in accordance with General Requirement I.2.F.(19). However, the life-cycle planning information needs to address the continued generation of this waste. The life-cycle planning information for continuing to generate a no path forward waste needs to include consideration of the necessity to generate the waste, an understanding of what prevents disposal of the waste, the needed capacity and capabilities for continued storage of the waste, and the plans for future disposal of the waste. Discussions would also be included on any alternatives to the process that generates the no path forward waste that have been considered.

Providing the life cycle information discussed above for waste streams already being generated is relatively straightforward. For most transuranic wastes, the information already exists and has been utilized for other documents such as the Programmatic Environmental Impact Statement and the Baseline Disposition Maps. To the extent that existing documentation includes the specified information, they may be used to meet the life cycle planning requirement.

Example: A transuranic waste generating facility operating at Site A continues to operate with no alterations. The facility generates the same transuranic waste streams it has been generating for years, and none of them are waste streams without a path to disposal. The life-cycle information about transuranic waste generated at this facility is included in the current waste inventories and capacities section of the Site A Radioactive Waste Management Plan, and no technical or programmatic issues are included in the Plan concerning these waste streams.

Waste generator planning prior to generation. Planning, prior to generating transuranic waste (subrequirement H.(1)), is intended to address transuranic waste streams that do not already exist. Transuranic waste streams that are first generated after issuance of the Order are subject to this requirement. Waste generator planning is a component of the waste generator program required in I.2.F.(7) of the General Requirements Chapter of DOE M 435.1-1. Waste generator planning activities need to be integrated in the generator program with waste characterization, certification, and transfer activities.

Example: A previously operating high-level waste treatment facility has been shut down for eighteen months and is to be restarted. Based on past experience, it is known that contamination control activities in the building will result in the generation of a transuranic waste stream. As part of the generation planning in support of the restart, plant personnel must evaluate the life-cycle of all of the waste streams (high-level,

transuranic and low-level) that will come from the facility. For the transuranic waste, personnel confirm that there is a facility that can accept the waste for storage and that because the waste is from a defense-related activity, it is eligible for disposal at the Waste Isolation Pilot Plant. Based on the WIPP waste acceptance criteria and communications with WIPP personnel, the determination is made that the waste will meet the waste acceptance criteria and that adequate capacity will be available. From the perspective of transuranic waste life-cycle planning there are no issues associated with the restart.

Generator planning addresses the life-cycle of the waste to disposal, including all interim steps of waste management. This can be accomplished by preparing a waste stream profile and reviewing it with the facility(ies) that will manage the waste. The waste stream profile format used needs to be consistent with the needs of the storage, treatment, and/or disposal facilities that will be involved in managing the waste stream. An example of a waste stream profile form is included as Figure III.H.1 at the end of this section of guidance. The waste generator confirms with each storage, treatment, and disposal facility that will be used, that based on the current knowledge of the waste stream characteristics, and planned facility capacity, the waste stream can be managed by the facility. It is therefore conceivable that a generator may have to interface with multiple facilities (e.g., a storage and/or treatment facility in addition to the disposal facility) to ensure that the waste can be managed.

Example: In the previous example, the treatment facility confirmed with the storage facility that based on the expected generation rate of the transuranic waste and the expected commencement of shipments of waste to WIPP that there was sufficient storage capacity to handle the transuranic waste stream.

The determination of whether a transuranic waste stream has an identified path to disposal is based on the availability and capacity of existing or planned facilities and operations. A planned facility is considered to be available if it has been authorized (e.g., a line item in a Congressional appropriation or equivalent approval for design and construction). A facility is not considered available if it is not authorized to accept or manage a particular waste type or concentration. If a planned facility is designated in the planning information, then the planning information also needs to address the schedule for when the facility will be operational, and the management steps that will be taken for waste designated for that facility until it becomes operational.

For purposes of planning for disposal of a transuranic waste stream, a facility or capabilities that are part of a program or strategic plan, but have not been authorized are not considered available. If a planned or available facility is canceled, the generator site needs to revise the planning for the life-cycle of the transuranic waste, an alternate path to disposal needs to be identified and documented, or approval to generate the transuranic waste needs to be obtained from the cognizant Field Element Manager as required by DOE M 435.1-1, Section I.2.F.(19).

The generator is responsible for ensuring that transuranic waste is not generated unless the life-cycle management, including disposal of the waste, has been considered. However, as discussed below, it is not the objective of this requirement to prohibit, under all conditions, the generation of transuranic waste that does not have an identified path to disposal. In meeting the DOE O 435.1 planning requirements, it is appropriate for waste management organizations to provide assistance to the generator in determining the waste management path, particularly in cases where the waste management organization may utilize offsite treatment, storage, or disposal facilities.

Compliance with this planning requirement is demonstrated by the individual sites establishing a process for evaluating the life-cycle of low-level waste prior to its generation, including the identification of low-level wastes with no path to disposal and appropriate records justifying the newly generated low-level waste stream(s), and site personnel possessing planning information showing the location(s) where low-level waste will be stored, treated, and/or disposed along with a confirmation that the personnel managing the facilities agree that the low-level waste may be managed at those facilities.

Supplemental References:

1. DOE, 1998. *Accelerating Cleanup: Paths to Closure,* DOE/EM-0362, U.S. Department of Energy, Washington, D.C., June 1998.

III. H.(2) Waste With No Identified Path to Disposal. Transuranic waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste.

Objective:

The objective of this requirement is to ensure that prior to generation of a new transuranic waste streams with no path to disposal, the need to generate the waste is carefully considered and plans

for safe long-term storage and for resolving issues that prevent disposal of the wastes are developed.

Discussion:

There are instances where programmatic needs may necessitate the generation of transuranic waste without an identified path to disposal. In these instances, the Field Element Manager must ensure development of a process for identifying generation of transuranic waste with no path to disposal and approving the conditions under which such transuranic waste can be generated (DOE M 435.1-1, Section 1.2.F.(19)). The process of identifying waste with no path to disposal and establishing conditions for its generation is intended to raise to the attention of DOE management that a long-term commitment is being made with the generation of such a waste, including prolonged storage of this waste and resolving those issues that prevent the waste from being disposed.

> *Example: Through generation planning it is determined that an Office of Science project will generate a small volume of non-defense transuranic waste. The generator contacts the waste management organization and learns that because the waste is non-defense it is not eligible for WIPP disposal. Working together, generator and waste management personnel determine there is no way to avoid creating the waste if the project proceeds, however, the waste management organization does have long-term storage capacity available. The Field Element Manager determines that due to the importance of the project, and based on plans that the Department is pursuing to resolve disposal of non-defense transuranic waste that generating the transuranic waste is acceptable.*

The minimum conditions for generating a waste without an identified path to disposal are identified in this requirement. They include various evaluations and considerations that involve both the waste generating and waste management organizations. The decision to proceed with the activity generating the wastes is made considering the factors discussed below.

<u>Programmatic need to generate the waste</u>. There must be a clear identification of the programmatic mission being served that results in the generation of transuranic waste with no identified path to disposal. Alternate means of accomplishing the mission without generating the waste should be discussed. These could include use of alternative materials to achieve the mission, use of different processes, or substitution of chemicals other than the ones originally to be used.

<u>Characteristics and issues preventing the disposal of the waste</u>. The reasons that the transuranic waste cannot be disposed of must be identified. These may be technical or programmatic reasons. For example, if a waste needs to be treated in order to meet a disposal facility waste acceptance criteria and an appropriate treatment facility is not available, the lack of treatment would be

identified as the reason the waste does not have a path to disposal. Identifying the characteristics and issues preventing disposal is necessary to support the development of plans for achieving disposal.

Safe storage of the waste until disposal can be achieved. Since the waste cannot be disposed of pending the resolution of programmatic or technical issues, facilities must be available for safe storage. In order to evaluate the ability to provide for the storage of the waste, there needs to be an estimate of the amount of the waste that will be generated, as well as an estimate of the time necessary to keep the waste in storage. Identification of the requirements for safe storage and acceptable storage facilities is a prerequisite to generating the waste so that unique or risky aspects that may make long-term storage problematic can be identified. In addition, treatment necessary to comply with RCRA, if applicable, should be identified.

Activities and plans for achieving final disposal of the waste. The decision to generate waste with no identified path to disposal must be based on a plan to eventually achieve disposal. The plan to achieve disposal of the waste needs to identify the activities being pursued to resolve issues preventing disposal and a schedule for their resolution. The activities described may be fairly detailed if the problems are technical and involve only one waste stream at a site. In other cases involving programmatic issues, or which involve several waste streams at several sites, the activities and schedules to resolve issues may be less certain because they are dependent on other internal or external organizations. For example, resolution of the issue of disposal of non-defense transuranic waste may require action external to DOE (e.g., legislation). Sites should defer to the complex-wide plans for addressing disposal of non-defense transuranic waste in lieu of developing individual plans and schedules.

Example 1: Approval is given to generate transuranic waste with no path to disposal. The waste is not acceptable for disposal at WIPP because it is reactive (EPA hazardous waste code D003). The approval to generate the waste is based on the generator providing plans to develop the treatment capabilities necessary to make the waste acceptable for WIPP disposal. These plans should be detailed, identifying the schedule for conducting the studies, tests, and engineering, as well as regulatory activities, necessary to allow the waste to be treated.

Example 2: A non-defense transuranic waste which is otherwise acceptable for WIPP disposal may require a programmatic decision by DOE Headquarters and legislative action to resolve disposal issues. The site plan for addressing this issue should identify the data collection and options analyses to be performed by the site and address how they fit with the actions being taken by the Complex-Wide Transuranic Waste Management Program (see DOE M 435.1-1, Section III.C).

If the assumptions for the planned management of the waste are adversely impacted (e.g., as a result of testing, design, funding profile, DOE policy) they should be updated. Minor updates to the assumptions and changes to the planned management of the waste would not be a basis for re-evaluating the generation of the waste as long as the overall plan remains essentially unchanged. However, major changes to the plan (e.g., changes in decisions for developing a treatment facility or disposal facility to handle the waste) must result in a re-evaluation of the acceptability of continuing to generate the transuranic waste. All changes in plans for resolving issues preventing disposal should be forwarded to the Headquarters Office of Waste Management so their impact on the Complex-Wide Transuranic Waste Management Program can reflected in the program plan (see DOE M 435.1-1, Section I.2.D.(1)).

Compliance with requirement is demonstrated by the waste generation organization having documentation concerning the decision to generate a transuranic waste stream that does not have an identified path to disposal. This documentation needs to include the cognizant Field Element Manager or designee approval to generate the waste, an explanation of the need for the process that generates the transuranic waste, a discussion of the reason it cannot be disposed of, the proposed management plan for the waste, and an up-to-date schedule of activities being pursued to resolve constraints to the disposal of the subject waste. Consistent with the use of a graded approach for applying DOE M 435.1-1 requirements, the schedule and plans for disposing of non-defense waste can defer to the complex-wide resolution of the issue.

Supplemental References:

1. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* DOE/WIPP-069, Revision 5, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

WASTE STREAM PROFILE FORM **Page 1 of 3**

Waste Stream Profile Number: ________________ Generator site name: ________________

Technical contact: ________________________ Generator site EPA ID : ______

Technical contact phone number: ________________

Did your facility generate this waste? Yes No

If no, provide the name and EPA ID of the original generator:

____

Waste Stream Information

ID: ________________________ Summary Category: ____________________

Waste Stream Name : ________________________________

Description from the TWBIR (if available): ________________________________

Defense TRU Waste?: Yes No CH-TRU or RH-TRU?: CH RH

Concentration of PCBs: ____

Number of SWBs _______ Number of Drums_______ Number of Canisters ___

Data package numbers supporting this waste stream characterization: __________________

List applicable EPA Hazardous Waste Numbers: ____________________________

List the concentrations of VOCs listed in Table 4-2: ________________________

List average isotope ratios: ____

List the weight fraction of CRP: ____________________________________

Acceptable Knowledge Information

For the following, enter supporting documentation used (i.e., references and dates)

Required Program Information

- Map of site: ____
- Facility mission description: ____
- Description of operations that generate waste: ______________________________
- Waste identification/categorization schemes: ______________________________
- Types and quantities of waste generated: ________________________________
- Correlation of waste streams generated from the same building and process, as appropriate: ____
- Waste certification procedures: ____

Figure III.H.1. Example Transuranic Waste Stream Profile Form

WASTE STREAM PROFILE FORM **Page 2 of 3**

Required Waste Stream Information

- Area(s) and building(s) from which the waste stream was generated: ________________
- Waste stream volume and time period of generation: ________________
- Waste generating process description for each building: ________________
- Process flow diagrams: ________________
- Material inputs or other information identifying chemical/radionuclide content and physical waste form: ________________
- Which Defense Activity generated the waste: (check one)
  - Weapons activities including defense inertial confinement fusion
  - Naval Reactors development
  - Verification and control technology
  - Defense research and development
  - Defense nuclear waste and material by products management
  - Defense nuclear materials production
  - Defense nuclear waste and materials security and safeguards and security investigations

Supplemental Documentation

- Process design documents: ________________
- Standard operating procedures: ________________
- Safety Analysis Reports: ________________
- Waste packaging logs: ________________
- Test plans/research project reports: ________________
- Site data bases: ________________
- Information from site personnel: ________________
- Standard industry documents: ________________
- Previous analytical data: ________________
- Material safety data sheets: ________________
- Sampling and analysis data from comparable/surrogate Waste: ________________
- Laboratory notebooks: ________________

Figure III.H.1. Example Transuranic Waste Stream Profile Form (cont.)

WASTE STREAM PROFILE FORM **Page 3 of 3**

Sampling and Analysis Information [1]

For the following, when applicable, enter procedure title(s), number(s) and date(s).

- Radiography: ____
- Visual Examination: ____
- Headspace Gas Analysis
  VOCs: ____

Homogeneous Solids/Soils/Gravel Sample Analysis

Metals: ____
PCBs: ____
VOCs: ____
Nonhalogenated VOCs: ________________________________
Semi-VOCs: ____
Other (specify): ____________________________________

Waste Stream Profile Form certification:

I hereby certify that I have reviewed the information in this Waste Stream Profile Form and it is complete and accurate to the best of my knowledge. I understand that this information will be made available to regulatory agencies and that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

______________________ ______________________ __________

Signature of site project manager   Printed name and title   Date

Note: (1) If radiography, visual examination, headspace gas analysis, and/or homogeneous solids/soils/gravel sample analysis were used to determine EPA Hazardous Waste Codes attach signed summary reports documenting this determination.

Figure III.H.1. Example Transuranic Waste Stream Profile Form (cont.)

III. I. Waste Characterization.

Transuranic waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

Objective:

The objective of this requirement is to ensure that sufficient knowledge of transuranic waste's characteristics (e.g., chemical, physical, radiological) is available to protect workers handling the waste and to support effective decision-making for its management. This information is to be maintained from generation, through storage and treatment in sufficient detail to ensure that the requirements of subsequent treatment and storage facilities, transportation regulations, and the disposal requirements for transuranic waste will be met.

Discussion:

The *Radioactive Waste Management Manual* assigns the Field Element Manager the responsibility of ensuring development, approval, and implementation of a program that addresses the responsibilities of waste generators, including waste characterization (DOE M 435.1-1, Section I.2.F.(7)). The characterization data acquired during generation, storage, and after treatment of transuranic waste need to be reliable and in sufficient detail to ensure subsequent management can be conducted safely and to meet the waste acceptance requirements of all subsequent receiving facilities. Accurate characterization of transuranic waste is essential to: 1) waste planning by generators, as required by DOE M 435.1-1, Section III.H; 2) waste certification by generators and other senders of waste, as required by DOE M 435.1-1, Section III.J; 3) waste transfers by generators and other senders of waste, as required by DOE M 435.1 Section III.K; and; 4) waste evaluation and acceptance by receivers of waste, as required by DOE M 435.1-1, Section III.G.

In conducting the analyses for development of the DOE M 435.1-1, characterization was identified as necessary to ensuring the safe management of waste from generation through disposal. Waste characterization is defined (DOE M 435.1-1, Definitions) as:

> "The identification of waste composition and properties, such as by review of acceptable knowledge (which includes process knowledge), or by nondestructive examination, nondestructive assay, or sampling and analysis, to comply with applicable storage, treatment, handling, transportation, and disposal requirements."

Accurate waste characterization is necessary so that the waste and waste containers are compatible and worker handling of waste containers can be performed safely. All information necessary for personnel to safely handle a container of transuranic waste needs to be known at all times during the life-cycle of the waste.

Waste characterization is a tool for gathering information that supports defensible decisions regarding safety, process, environmental and compliance matters in the management of transuranic waste. The significance of the waste management decision will guide the graded application of this requirement, as well as the more detailed characterization requirements addressed in subsequent sections of this guidance. These subsequent sections address application of a data quality objectives process to guide characterization (Section III.I.(1)) and minimum characterization requirements (Section III.I.(2)).

Use of Direct and Indirect Methods. Waste managers are to characterize transuranic waste using an appropriate combination of direct and indirect methods. The appropriate method for characterizing waste depends on the parameter being measured, the hazards associated with acquiring the information, and the amount and quality of the data needed as determined through a data quality objectives or similar process.

Direct methods of characterizing waste can be used to established certain physical and chemical attributes as well as radiological characteristics. The most common direct methods for characterizing the chemical and/or radiological characteristics are sampling and laboratory analyses and certain nondestructive evaluation techniques (e.g., real-time radiography). Direct characterization methods are conducted in accordance with the quality assurance program and plan governing the site and laboratory facilities.

Indirect methods of characterization use non-destructive examination techniques and acceptable knowledge to replace, supplement, and/or initially provide data that might otherwise be collected by direct, intrusive characterization of the waste. In the safety and hazard analysis performed in support of development of DOE M 435.1-1, the use of indirect methods was identified as an appropriate means of characterizing waste and at the same time complying with the as low as reasonably achievable (ALARA) principle for keeping radiation exposures to a minimum. An additional benefit of characterizing transuranic waste by the use of indirect methods is the avoidance of the generation of waste associated with sample materials, and laboratory equipment and expendables.

In order for indirect methods of transuranic waste characterization to serve their purpose of providing information necessary for the safe management of waste, the data need to be sufficiently accurate. The level of accuracy is determined through application of data quality objectives, or comparable process. Consistent with the data quality objectives, correlations demonstrating that data provided by indirect methods are representative of the actual waste may need to be

supported through the application of direct methods. The methodology could employ a number of techniques, some of which involve some direct sampling and analysis of the waste stream. The following guidance paragraphs discuss different indirect methods.

Similar to the EPA and NRC guidance on characterizing mixed waste, DOE endorses the use of indirect methods such as the use of "acceptable" or "waste knowledge" for characterizing physical, chemical, RCRA-regulated, and radioactive components of waste. The term "acceptable knowledge" (or "waste knowledge") includes process knowledge; records of analyses performed prior to the effective date of a requirement; or a combination of process knowledge and previous records, supplemented with chemical analyses (NRC/EPA, 1997). Process knowledge refers to detailed information on processes that generate waste subject to this requirement or information on processes similar to those which generated the waste being characterized.

Acceptable knowledge characterization of transuranic waste is based on an understanding of the materials and processes used to generate the waste, or analytical data obtained from the process or waste stream or both. Acceptable knowledge also includes information regarding the source of the waste stream, the physical form and materials comprising the waste, the chemical constituents of the waste, and the nature of the radioactivity present. Acceptable knowledge may be used to describe transuranic waste if the source information is consistent, defensible, and auditable.

While the development of a process for identifying and documenting transuranic waste acceptable knowledge is not dictated by this requirement, the following guidance provides an overview of elements of an acceptable process for assembling acceptable knowledge documentation:

- Acceptable knowledge is compiled in an auditable record.
- Correlations within waste streams in terms of time of generation, waste generating processes, analytical data, and site-specific facilities are clearly described.
- A reference list of applicable documents, databases, quality control protocols, and other sources of information that support the acceptable knowledge information is prepared.
- Procedures which outline the methodology that is to be used to identify and assemble auditable acceptable knowledge records, including the origin of the documentation, how the assembled information was or will be used, and any limitations associated with the information.

Characterization data gained through acceptable knowledge must be within the acceptable range of certainty and precision identified by the data quality objectives or similar process. Additionally, the effects of time-dependent processes must either be negligible or predictable. If acceptable

knowledge is supported by the collection, analysis, and comparison of statistically valid samples with the acceptable knowledge records, periodicity of sampling and analysis should correlate with the nature of any changes in the process creating the waste or with changes that are being documented in characterization data.

Non-destructive examination and assay techniques use methods such as passive-active neutron assay, high resolution gamma ray spectroscopy, and thermal neutron capture to non-destructively collect data relating to the radionuclide constituents in the waste. Acceptable performance of assay techniques is determined through measurement of known standards and comparison to established quality assurance objectives of the applicable characterization program. A process, similar to the one discussed above regarding acceptable knowledge, needs to be established and documented in site procedures that outline the exact nature of the acceptable use of non-destructive examination techniques for providing characterization information on waste.

Another indirect method of providing radionuclide characterization data is through the use of a known relationship, or scaling factors, between a measured radionuclide or a dose rate and the radionuclide(s) of interest. As discussed above for acceptable knowledge and non-destructive examination techniques, use of scaling factors must be correlated with actual data.

The use of scaling factors is generally established by an initial characterization that provides a statistical basis for use of the scaling factors. As with any indirect method, the characterization program needs to include confirmatory measurements. The frequency of the confirmatory measurements is to be based on the consistency of the process generating the waste. Additionally, the history of previous confirmatory measurements may also influence the frequency of future confirmatory measurements with results that are very consistent providing justification for less frequent confirmatory measurements.

> *Example: A waste stream from an actinide processing building is sampled and analyzed and determined to be composed of three primary nuclides: Pu-239, Am-241, and Pu-238. The samples are found to contain the three radionuclides in essentially the same ratio. The process is known to be uniform and is therefore expected to generate similar concentrations in the waste stream as the facility is operated. Therefore, the contents of future waste containers are routinely characterized based on a gamma energy analysis which detects gamma radiation from the Am-241 and Pu-238. The characterization program requires the collection and full analysis of samples once a month to confirm that the ratio of the three radionuclides falls within an acceptable range (based on application of the data quality objectives process).*

Characterization Documentation. The requirement states that characterization data shall be documented in sufficient detail to enable the waste acceptance requirements of the receiving

facility to be met. The following elements are considered essential to this process for acquiring and controlling characterization data:

Organization(s) and Responsibilities - Identification of the organizations involved and responsible for characterization of transuranic waste.

Quality Assurance - Characterization data need to be subjected to a quality assurance program and the program that applies needs to be identified and documented.

Procedures - The process for obtaining waste characterization data is formalized in procedures which describe to the user the steps that are to be followed and the administrative process for ensuring the data are of the quality needed. Topics that need to be proceduralized include the processes for sampling, packaging, transportation, laboratory analysis, and data control.

Procurement/Purchasing Controls - The procurement and/or purchasing of items or services that are significant to characterizing transuranic waste are controlled and documented. Such procurement includes the purchase of sampling equipment and sample transport containers, as well as services such as laboratory analyses (onsite or offsite). As dictated by the type of procurement, the documentation needs to include (or reference) the technical specifications for the item/service being procured, identification of quality assurance requirements including any required inspections, specifications of documentation requirements (e.g., certification of compliance or conformance, laboratory analytical results), and a statement ensuring access to the provider's facilities as necessary to perform audits and inspections. The characterization data need to be traceable through the provider's process of generating them and verifying their accuracy.

Document/Data Change Control - Records that contain characterization data, whether they have been generated through sampling and analysis, nondestructive assay, or acceptable knowledge, need to be controlled. In addition, the waste characterization procedures and quality assurance program documentation are subject to document control. Document and data control need to include review, approval, and distribution to designated recipients (users), and a controlled process for making revisions to documents or data. Existing document and data control programs at a site may be adequate to provide the necessary controls for documents related to transuranic waste characterization data, but will need to be reviewed to ensure the objectives of DOE M 435.1-1 requirements are met.

Training - Characterization data are generated and managed only by personnel that are properly trained to recognize the significance of the data. Generally, training of laboratory personnel will be adequate to support transuranic waste characterization, but needs to be

reviewed versus the goals of the characterization. Other staff managing and using characterization data need to understand what is to be done with the data (i.e., what decisions are to be made) once data are collected.

Records - Waste characterization records include those that are necessary to meet the waste acceptance requirements of receiving facilities, and as specified by the waste certification program DOE M 435.1-1, Section III.J.

As noted above, existing programs at a site may provide the framework within which the elements of waste characterization can be addressed (e.g., quality assurance, training, document control).

The waste acceptance requirements of a facility to which the waste is sent also may impose additional requirements on what is to be included in the waste characterization data. The waste acceptance requirements for the receiving facility include specific quality assurance, administrative, or documentation requirements so that waste characterization data are acceptable to the facility.

Example: A site is preparing to transfer waste to WIPP for disposal. The waste characterization program at the site normally generates data on the physical, chemical, and radiological characteristics of the waste. However, additional requirements have been established for the characterization of transuranic waste in order to transfer it to the WIPP for disposal. In addition to what is normally thought of as characterization data (chemical and radiological), the waste acceptance criteria require, among other information, the waste packages to be characterized in terms of their thermal power and decay heat.

Compliance with this requirement is demonstrated by a program for documenting and the existence of records that document the process for acquiring and verifying the validity of transuranic waste characterization data acquired through the use of direct or indirect methods.

Supplemental References:

1. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* DOE/WIPP-069, Revision 5, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

2. EPA, 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

3. NRC/EPA, 1997. "Joint NRC/EPA Guidance on Testing Requirements for Mixed Radioactive and Hazardous Waste," *Federal Register*, Vol. 62, No. 224, U.S.

Environmental Protection Agency and U.S. Nuclear Regulatory Commission, November 20, 1997.

III. I.(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Objective:

The objective of this requirement is to invoke a process for determining the type, quantity, and quality of characterization data needed to support the safe management of transuranic waste so as to ensure that needed data are acquired, the data meet the objectives they are being collected for, and resources are not wasted on unnecessary, incomplete or unusable data collection efforts.

Discussion:

The type, quantity, and quality of characterization data obtained for the safe management of transuranic waste need to be consistent with the purpose for which the characterization information will be used. The uses of transuranic waste characterization data include complying with storage, treatment, and disposal facilities' waste acceptance requirements; determining radiation shielding and other protective measures; evaluating compliance with processing requirements; and meeting legislative or regulatory commitments. This requirement is included in DOE M 435.1 to ensure that the appropriate characterization data to support the safe management of transuranic waste are generated. The requirement is intended to promote a structured process for the collection and use of transuranic waste characterization data and to avoid the collection of data that is neither necessary nor defensible.

Input from various waste management organizations and interested groups is necessary to establish a clear understanding of the characterization data needs and the level of data quality that is acceptable for making transuranic waste management decisions. The current requirement invokes the use of a structured process for determining the type, quantity, and quality of characterization data needed. Such a process, called a data quality objectives process, has been developed by the Environmental Protection Agency and is documented in *Guidance for the Data Quality Objectives Process*. Application of the EPA process and use of the guidance for the use of the data quality objectives process is an acceptable method of meeting this requirement. However, use of other comparable processes that employ a structured approach to yield similar results is also acceptable.

The objectives of applying a structured process such as the data quality objectives process are to:

- manage and control the risks of making incorrect decisions;
- determine the data required to support making specific decisions;
- determine the type and quality of required data;
- allow stakeholders, decision makers, data users, and relevant technical experts to participate in planning and assessment;
- determine the quantity, location, and type of samples required;
- quantify the uncertainty in data through development of statistical sampling plans; and
- reduce overall costs by identifying resource-efficient sample collection and analytical methods by optimizing the sample and analysis plans.

The data quality objective process is a strategic planning approach based on the scientific method that is used to prepare for a data collection activity. The value of using this process to develop transuranic waste characterization parameters is that it reduces radiation exposure and saves resources by making characterization data collection operations more resource-effective; enables characterization data users and others to participate in characterization data planning; and provides a structured method for defining characterization data performance requirements, i.e., quality.

To foster the development and implementation of an effective data quality objectives or similar process, individuals are assigned responsibility for specific activities for each application of the process. Key activities of the process include:

- preparing the data quality objectives documentation;
- identifying stakeholders;
- identifying technical experts;
- ensuring opportunities for input and coordinating stakeholder and technical experts into the data quality objective process;
- reviewing and commenting on the developed data quality objectives; and

- approving the data quality objectives documents.

A more detailed description of the assignment of specific responsibilities for implementing a data quality objectives or similar process is presented in the Hanford "Data Quality Objectives Procedure" (see reference 2).

The data quality objectives process consists of seven steps. The output from each step influences the choices that will be made later in the process. Even though the data quality objectives process is depicted as a linear sequence of steps, in practice it is iterative; the outputs from one step may lead to a reconsideration of prior steps. This iteration is encouraged since it will ultimately lead to a more efficient data collection design. During the first six steps of the process, a team of process-cognizant personnel develop decision performance criteria (i.e., data quality objectives) that will be used to develop the data collection design.

The final step of the process involves developing the data collection design based on the data quality objectives developed in the first six steps. The first six steps need to be completed before the team attempts to develop the data collection design because the design is dependent on a clear understanding of the first six steps taken as a whole.

Following is a listing and brief description of each of the seven steps. This is followed by an example of how the data quality objectives process can be applied to transuranic waste characterization.

1. *State the Problem* – Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

2. *Identify the Decision* – Identify what questions the study will attempt to resolve, and what actions may result.

3. *Identify the Inputs to the Decision* – Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

4. *Define the Study Boundaries* – Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.

5. *Develop a Decision Rule* – Define the statistical parameter of interest, specify the action level, and integrate the previous data quality objective outputs into a single statement that describes the logical basis for choosing among alternative actions.

6. <u>Specify Tolerable Limits on Decision Errors</u> – Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

7. <u>Optimize the Design</u> – Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all data quality objectives.

Example: In order to comply with current legislation, the Waste Isolation Pilot Plant has established a waste acceptance criterion that transuranic waste must exceed 100 nCi (3700 Bq) of alpha-emitting transuranic nuclides per gram of waste. At the CST Site waste management personnel worked with the WIPP staff, site laboratory personnel, and members of the local citizens advisory board to address the transuranic waste determination issue. The question is formulated as, what are the analytical criteria waste must meet in order to be categorized as transuranic waste? The answer to this question makes a significant difference in cost and in the amount of waste that will be shipped to WIPP, and conversely, the amount of waste that will be designated as low-level waste and disposed of near surface. From the perspective of worker protection, it was recognized that a non-intrusive analysis technique was preferred. The CST Site personnel anticipated that most of the waste would be around 200 nCi/g (7400 Bq/g) so they opted for a two-tiered characterization approach which employs a fast, inexpensive protocol to make an initial screening of waste and a slower, more expensive protocol to characterize waste that fails the initial screening. The data quality objective is:

> *Waste containers will be categorized as transuranic waste if the results of the non-destructive analysis exceed the minimum detectable concentration for a particular assay system and protocol, and the results exceed 100 nCi/g. Waste containers will be initially analyzed using a system and protocol that has a minimum detectable concentration of 150 nCi/g. If the result does not exceed 150 nCi/g, the waste container will be analyzed using a system and protocol with a minimum detectable concentration of no more than 50 nCi/g.*

Applying this data quality objective, a waste container is assayed as having 175 nCi/g using the first system (150 nCi/g minimum detectable concentration) and categorized as transuranic waste. Another waste container assayed as having 125 nCi/g using the first system. Even though the assay exceeds 100 nCi/g, the categorization would be indeterminate because the assayed value is less than the minimum detectable concentration. An assay of the container using the second system (50 nCi/g minimum detectable concentration) yields a result of 110 nCi/g. Based on the second measurement the waste is categorized as transuranic.

The above description of the use of the data quality objectives process, and the example, are provided as an introduction to the process. A more detailed description of the process can be found in the referenced EPA guide. The data quality objectives process is most useful during the planning stages of identifying transuranic waste characterization and uncertainty parameters, i.e., before the data are needed and collected. The value of the process is diminished significantly if the characterization data have already been collected because there is a tendency to make the questions that need to be answered fit the available data. The application of the data quality objectives process is applied in a graded manner, i.e., the depth of detail and the magnitude of the resources expended in implementing the process should be commensurate with the relative importance of the characterization data in terms of the decisions to be made and protection of the public, workers and the environment.

The intent of this requirement is not that waste streams with characterization processes already in place and accepted by storage, treatment, and disposal facilities be recharacterized using the Data Quality Objectives Process, or a comparable process, or that the characterization processes be revised using the Data Quality Objectives Process, or a comparable process. The intent is that, as new waste streams are identified and generated, the Data Quality Objectives Process, or a comparable process, be used for identifying characterization parameters and acceptable uncertainty in characterization data. If the characterization parameters of an existing waste stream characterization process are to be significantly modified, then the Data Quality Objectives Process, or a comparable process, should be used.

Compliance with this requirement is demonstrated by the documented use of a data quality objectives or a comparable process for determining the type, quantity, and quality of characterization data needed to safely manage transuranic waste.

Supplemental References:

1. EPA, 1994. *Guidance for the Data Quality Objectives Process,* EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C., September 1994.

2. WHC, 1996. *Data Quality Objectives Procedure*, WHC-IP-1216, Revision 1, Westinghouse Hanford Company, January 31, 1996, (included as Appendix A in draft Manual HNF-SD-WM-PROC-021, Revision 0, Lockheed Martin Hanford Corporation, January 2, 1997).

III. I.(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) **Physical and chemical characteristics;**

(b) **Volume, including the waste and any stabilization or absorbent media;**

(c) **Weight of the container and contents;**

(d) **Identities, activities, and concentrations of major radionuclides;**

(e) **Characterization date;**

(f) **Generating source;**

(g) **Packaging date; and**

(h) **Any other information which may be needed to prepare and maintain the disposal facility performance assessment or demonstrate compliance with applicable performance objectives.**

Objective:

The objective of this requirement is to establish minimum transuranic waste data that have been determined to be necessary for safe and effective management during the life cycle of the waste.

Discussion:

In the process of developing DOE O 435.1 and DOE M 435.1-1, the safety and hazard analysis indicated that certain characterization data were critical because several consequences could be avoided or minimized if certain basic information was accurately known about transuranic waste. This requirement identifies those critical characterization data points that must be known for safe handling and proper management. The sections below provide guidance on each of these specific characteristics.

Physical and Chemical Characteristics. Physical characteristics support handling and packaging activities. Parameters include a description of the material, its density, consistency, and appearance. Chemical characteristics impact handling, storage, containment, and can impact treatment processes. These characteristics determine the compatibility of the waste with other waste and the waste container, as well as its compatibility with proposed treatment processes. Parameters include pH, reactivity, chemical compounds present, and the presence of hazardous

and/or toxic constituents. Physical and chemical characteristics can be determined directly by visual examination and/or sampling and analysis. Physical characteristics can be determined directly, indirectly by use of acceptable knowledge and/or by non-destructive examination techniques such as computer tomography or real-time radiography. Chemical characteristics can also be determined by use of acceptable knowledge.

Volume and Weight. Volume and weight information is necessary for proper control of storage and disposal facility capacities as well as proper payload control for transportation and handling systems. Typical parameters include:

- container volume, measured as the external volume of the waste container which represents the volume that will be occupied in a storage or disposal facility (e.g., 55 gallon drum or 120 cu ft (for a 4 x 5 x 6 box));
- actual waste volume, including stabilization media;
- container weight; i.e., the total weight of the container and all of its contents (waste, shielding, stabilization media) that would have to be handled;
- identification of the stabilization medium, if used; and
- waste container utilization factor, measured as the percentage of the packaging volume that is filled with waste, including stabilization media. This parameter does not require an individual calculation be made of stabilization or absorbent media volume, but that those media be included in the total waste volume calculation.

These characteristics are generally determined by acceptable knowledge (e.g., container size, stabilization medium) or by measurement (e.g., weight).

Radionuclide Data. Radionuclide information allows for proper control of thermal loads for storage and disposal facilities, determination of personnel safety procedures, control of total activity limits for transportation, storage, and disposal, and also determination of the waste type. Parameters which constitute radionuclide information may include the following:

- total activity in the container, in curies;
- identity and activity per unit mass of the major radionuclides. For purposes of this guidance, major radionuclides are those which affect the determination that a waste is transuranic waste and any others determined to be of importance to the receiving facility (e.g., by safety analysis, performance assessment, etc.);

- radiation dose levels at the surface of the container; and

- container external surface contamination levels.

These characteristics can be determined directly by smear survey or radiochemical analysis of the waste, or indirectly by waste package non-destructive assay, radiation survey, and/or by documentation of nuclear materials accountability information or individual assays performed on components contained in the container.

Date and Generating Source. Date and generating source information helps to determine the validity of currently held documentation on the waste, which, in turn, will determine the need for additional sampling or analysis. Parameters include characterization date, packaging date, DOE site, building location of the process which generated the waste, and the generating process, if available.

Performance Assessment and Compliance Data. Additional data about waste that are important to performance or evaluating performance of the disposal facility, or to complying with laws, applicable regulations, or authorizing conditions (e.g., of a permit) may also need to be collected. The specific data needed will, by necessity, be identified by the disposal facility operator. Parameters which need to be included with waste characterization data may be identified by the analysts developing the disposal facility performance assessment, specified through conditions imposed on the site through the review and approval of the performance assessment, or derived from internal regulatory compliance evaluations. Examples of the types of data that may be needed are the presence and amounts of chelating agents which can enhance the transport of radionuclides from the disposal facility, or the presence and concentrations of specific chemicals which are not acceptable above specific limits (e.g., reporting polychlorinated biphenyls concentrations versus a limit of 50 ppm).

All of these data may not be required for a particular phase in the management of the waste's life cycle. The specific data needed will be determined by the waste acceptance criteria of a particular receiving facility.

> *Example: Experimental work in a laboratory generates a liquid transuranic waste stream that is transferred via a pipeline to a central storage tank. Although the minimum characterization requirements include "weight of the container and contents," this is not relevant to this waste stream and the characterization data in the waste acceptance requirements for the central storage tank do not include packaging weight.*

Compliance with this requirement is demonstrated by the existence of a program or procedures for determining and records that document characterization of transuranic waste consistent with the minimum characterization data requirements.

Supplemental References: None.

III. J. Waste Certification.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving transuranic waste for storage, treatment, or disposal are met.

Objective:

The objective of this requirement is to ensure that waste transferred to a facility for storage, treatment, or disposal meets the receiving facility's waste acceptance requirements, to reduce the likelihood that transferred wastes contain unacceptable materials or characteristics, and to avoid hazards that would occur from the transportation and handling of waste packages which do not meet acceptance requirements. Certification also ensures that the storage, treatment, or disposal facilities receiving the waste operate within limits established through safety analyses and/or performance assessments.

Discussion:

The *Radioactive Waste Management Manual*, General Requirements, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the responsibilities of waste generators (DOE M 435.1-1, Section I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the waste acceptance requirements of the facility to which it is transferred. The generator requirements address generation planning, waste characterization, waste certification, and waste transfer. As discussed in this guidance, a certification program is to be established by generators of radioactive waste to provide a mechanism for confirming that waste is in compliance with the waste acceptance criteria of the facility to which the waste is being transferred. The certification program is required by any organization or facility that transfers waste to another facility.

> *Example: The Transuranic Waste Storage Facility has transuranic waste that it has received for storage over the last 10 years. Facility personnel plan to continue to receive transuranic waste and store it until it can be transferred to WIPP. The organization responsible for the storage facility must have a certification program through which facility personnel confirm the waste meets the acceptance criteria for WIPP . Since the storage facility does not change the characteristics of the waste package, the facility waste acceptance requirement should ensure that the waste they receive is acceptable for WIPP disposal. In this particular example, the certification program would have to be in accordance with the Generator Site Certification Guide (CAO, 1997).*

The certification program is part of the waste generator program that is approved by the Field Element Manager or designee. The certification program requires that an authorized official confirms compliance with the waste acceptance requirements of the facility to which waste is being transferred. Additional guidance correlated to the specific waste certification requirements of the Transuranic Waste Requirements Chapter is provided below.

Program Development and Documentation. The waste certification program should consist of a documented, structured process that works in concert with the DOE M 435.1 requirements for waste acceptance (Section III.G) and waste transfer (Section III.K) to control the transfer of waste to a storage, treatment, or disposal facility. Development of the waste certification program involves defining and documenting controls for those items and activities that affect certifying that a waste and its packaging meets the waste acceptance criteria of the receiving facility. The documentation should include the following:

Organizations and Responsibilities - Certification program documentation needs to identify the organizations and officials involved in the certification process and the responsibilities of each. Officials who are authorized to certify waste are identified in the documentation.

Quality Assurance - The certification program is subject to quality assurance. The quality assurance controls that apply to waste certification activities needs to be identified and documented. The use of an existing quality assurance program under which the certification activities will be performed is acceptable and appropriate.

Procedures - The process for certifying waste is formalized in procedures. The procedures need to describe to the user the steps that are to be followed and the administrative process for ensuring waste containers are certified. The procedures require a signed statement certifying waste meets the appropriate criteria. The procedures also document the steps necessary for complying with the applicable transportation requirements (e.g., requirements from a safety analysis report for packaging and/or from Title 49, Code of Federal Regulations).

Procurement/Purchasing Controls - The procurement and/or purchase of items or services that are significant to certifying that waste meets the waste acceptance criteria of a receiving facility need to be documented. Such procurement may include the purchase of materials such as waste containers or laboratory services (onsite or offsite). As dictated by the type of procurement, the documentation should include (or reference) the technical specifications for the item/service being procured; identification of quality assurance requirements including any required testing or inspections; specification of documentation to be provided on delivery (e.g., fabrication inspection and/or test records; a certificate of compliance or conformance, laboratory analytical results); and a statement ensuring access

to the provider's facilities as necessary to perform audits and inspections. The certification program ensures that the procurement documentation is reviewed and approved by an official with knowledge of the need, intent, and requirements for the procurement. The program also provides for documented verification commensurate with the relative importance and complexity of the items or services being procured.

Document Control - The principal documents that constitute the certification program needs to be subject to document control. Program documentation will identify which documents are to be controlled. The waste certification program description, waste certification procedures, and quality assurance program documentation need to all be subject to document control. Document control includes review and approval, distribution to designated recipients (users), and a controlled process for making changes to the documents. Existing document control programs at a site may provide the necessary controls for documents that are part of the waste certification program.

Training - The certification program needs to identify the training requirements for the various individuals who are involved in the program. At a minimum, the program will require training of the official who certifies that the waste meets the waste acceptance criteria of the facility(ies) to which it is being transferred. In addition, individuals will need to be trained in the procedures that control the part of the certification process with which they are involved.

Records - The certification program documentation needs to describe the management of certification records (see guidance for subparagraph (1) of this Waste Certification requirement).

Example: A site generates a small amount of transuranic waste that is sent to a central facility managed by a waste management organization. The generating organization works with the receiving facility to define the waste certification program for the site. Through a review of the existing site procedures, site personnel determine that the waste certification program can operate under the existing site quality assurance program, document control program, procurement process, and records management program. However, they determine that the site training program does not adequately address the certification process. Consequently, the waste managers work with the training department to develop a training module that explains the purpose and process of waste certification. The certification program documentation would identify these other programs as applicable, specify the facilities from which waste would be transferred, designate the officials responsible for waste certification at those facilities and their training requirements, and develop procedures (within the document control program) that ensure compliance with the waste acceptance criteria. Within the

existing programs, site personnel would identify the records to be maintained and retention times, technical specifications and receipt requirements for obtaining waste packaging materials, and requirements for analytical data. Operating within the parameters defined by the program, the waste generators would be able to certify waste for transfer to the onsite receiving facility.

As noted in the preceding example, existing programs at a site may provide the framework within which elements of the waste certification program can be addressed (e.g., quality assurance, training, document control). The waste acceptance requirements of the facility to which the waste is to be sent may impose additional requirements on what is to be included in the waste certification program. Whether the waste acceptance requirements of the facility to which waste is transferred mandate a waste certification program (e.g., a commercial facility), the organization transferring the waste is responsible for developing and implementing a certification program to provide internal assurance that the waste acceptance requirements will be met.

Implementation. The waste certification program is implemented through the use of the documented controls, processes, and procedures. The key document in a waste certification program is the certification statement or equivalent. The certification statement is the documentation signed by a designated official that certifies that the waste meets the appropriate requirements. The list below, derived from the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, is a generic listing of the topics that are recommended for consideration in development of certification statements.

1. Container and Physical Properties

    - container type or description
    - labeling/markings
    - weight
    - vents
    - liquids

2. Nuclear/Radiological Properties

    - fissile content
    - transuranic activity
    - other radioactivity
    - dose rate
    - surface contamination
    - thermal power

3. Chemical Properties

- mixed waste
- polychlorinated biphenyls
- other hazardous constituents
- pyrophorics
- explosives
- corrosives
- compressed gases
- volatile organic compounds

4. Packaging/Shipping Data

- packaging
- shipping information

Graded Approach. A graded approach is used in implementing the waste certification program. The above list is recommended for the intersite transfer of transuranic waste. Intersite transfers involve certifying that the waste is in compliance with the requirements for the receiving facility itself, and also in compliance with Department of Transportation requirements. However, even though the above list should be considered, it may be shortened and simplified for onsite transfers where the organizational relationships and knowledge of waste and waste generating activities may reduce the information that needs to be documented and transferred with each individual waste container or shipment. For onsite transfers, much of the information may already be available to the receiving facility. Onsite transportation of waste should be certified as meeting Department of Transportation requirements or site-specific requirements for transportation.

> *Example: For onsite transfers the receiving facility/organization may already have a waste stream profile provided by the generator facility/organization. Because of the existence of the waste stream profile, the certification may be as simple as an individual trained to the waste packaging and certification procedures signing a waste pick-up request that provides the radionuclide inventory of the waste packages being transferred and the waste stream identification number.*

The waste acceptance requirements of the facility receiving the waste (see DOE M 435.1-1, Section III.G) may dictate additional items which must be part of the certification statement. Even if such information is not dictated by the receiving facility, the waste acceptance criteria should be used to identify key elements to include on the waste certification statement.

Compliance with the development and documentation portion of the certification requirement is demonstrated by a waste certification plan that identifies the organizations involved, assigns

responsibilities for implementing the program, and describes or references the quality assurance, training, procurement controls, records management, and procedures to be used by the program. Acceptable performance for implementing the program is demonstrated when the appropriate personnel are trained, and have and follow the procedures that govern their part of the waste certification process. Acceptable performance also requires that the waste certification plan and procedures are current and controlled in accordance with a document control program, and records related to certification (e.g., certification statements, training records, procurement records, characterization records, container records) are generated and managed in accordance with the established site program.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1997.

2. DOT. *Shippers-General Requirements for Shipments and Packagings*, 49 CFR Part 173, U.S. Department of Transportation, Washington, D.C.

3. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. J.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

Objective:

The objective of this requirement is to ensure waste certification programs are developed that clearly identify the documentation required for certifying waste, specify personnel with the authority to make the certification, and provide a traceable and verifiable record of and basis for certification.

Discussion:

Officials who have the authority to certify that waste meets the waste acceptance requirements of the receiving facility must be designated by a cognizant manager. To avoid having personnel who are not knowledgeable of waste acceptance and transfer requirements authorizing the release of waste, the program needs to identify, by title or name, the officials who are authorized to certify. The official(s) are qualified by virtue of position, responsibilities, and training to make this certification. The official(s) have sufficient familiarity with the waste being generated and have been trained relative to the acceptance criteria of the facility receiving the waste for storage, treatment or disposal (and applicable transportation requirements) to be able to certify in writing that the waste is acceptable for transfer. The official(s) need to also have authorization from the facility receiving the waste to transfer the waste (see DOE M 435.1-1, Section III.K). Implementation of this element should be tailored to specific site needs and situations.

> *Example: Onsite transfers from multiple laboratories or processes to a central waste management facility may involve training multiple personnel (e.g., one for each laboratory or process) who have the authority to certify waste as meeting the onsite waste acceptance requirements. However, for the transfer of waste from the central waste management facility to an offsite facility, there may be a designated official at the site who has been trained relative to the acceptance criteria of the offsite storage, treatment, or disposal facility waste acceptance criteria and transportation requirements that is authorized to certify the waste as ready for shipment.*

The waste certification program needs to specifically identify the documentation to be produced to support the certification that waste meets the waste acceptance criteria of the receiving facility. The required documentation may include the following:

<u>Waste Stream Profile</u> (or record relating the waste to a previous profile). The waste stream profile is a description of the waste stream, generally identifying the source, physical and chemical description, and upper limits on radionuclides.

<u>Radionuclide Characterization Data</u>. Radionuclide characterization data include the concentration and/or inventory of radionuclides as determined by characterization (see guidance for DOE M 435.1-1, Section III.I, Waste Characterization).

<u>EPA Uniform Hazardous Waste Manifest</u>. The EPA manifest is required by 40 CFR Part 262 for the transfer of a hazardous or mixed waste.

<u>Waste Container Data and Integrity Maintenance Documentation</u>. Container data include information about the container dimensions, other physical attributes, and

procurement information. Integrity documentation includes the records of ownership and transfer of waste containers and data. (See guidance for Waste Transfer, DOE M 435.1-1, Section III.K).

Radiological Survey Results (or documentation referencing a survey record). Survey results include the determination of the surface contamination of the waste container and the external dose rate.

Bill of Lading. A document indicating the contents of a shipment.

Real-Time Radiography Results. The results of radiography performed to detect unallowed material in the waste package (e.g., liquids, compressed gas cylinders).

Certification Statement. The statement required by DOE M 435.1-1 to document that waste is in compliance with the acceptance criteria of the facility to which the waste is being transferred.

Authorization to Transfer. Documentation indicating that an official from the facility to which the waste is to be transferred has authorized transfer of the waste to the facility.

As noted for other elements of this requirement, the organization developing the certification program uses a graded approach in determining which of these documents are needed. Regardless of the extent of the required documentation, the certification statement can serve as a checklist that all of the waste acceptance criteria have been considered and the waste is in compliance. An example of a certification statement for waste to be shipped to WIPP is provided at the end of this section of guidance (Figure III.J.1).

In order to ensure that information is available if or when it is needed in the future, the waste certification program should identify which records are to be maintained and how they are to be maintained. The certification program documentation may include specific records management requirements, or may simply invoke an existing acceptable records management program. Although no minimum record retention times are established in DOE M 435.1-1, certain records may need to be maintained indefinitely. Whereas hazardous waste regulations require only a three-year retention period, DOE disposal facilities should plan on maintaining pertinent records at least through the operations, closure, and post-closure monitoring periods, and consider making them part of any local land use records. The pertinent records would be those which identify physical, chemical, and radiological characteristics of the waste and the certification of that information. Generating, storage, or treatment facility waste management records may not be required beyond the life of the facility or operation, provided pertinent information has been supplied to the facility where the waste will be disposed.

Example: Personnel at a storage facility maintain records describing when they received waste, what the waste was (characterization and container data provided by the generator), and to whom the waste was eventually transferred. Once the waste is disposed of and the waste characterization and container information is in the possession of the organization responsible for the disposal facility, the organization responsible for the storage facility disposes of its records.

To meet the requirement for auditability and retrievability, the method of records storage and retention needs to allow a person to trace shipment or waste container information back to the generator certification data (e.g., characterization data, source data, container data). In accordance with the DOE M 435.1-1, Section III.K Transfer Requirements, information on the source and characteristics of the waste are to be transferred when waste is transferred. It is not the intent of this requirement that a certification statement be generated for existing waste that was received without such information (i.e., waste in storage as of the issuance of DOE O 435.1). However, such documents must be created for any subsequent transfers of waste.

Example: A site should be able to provide the characterization, container, and certification information for any waste container within a storage, treatment, or disposal facility if that waste container is transferred after issuance of DOE O 435.1.

Compliance with this requirement is demonstrated by a program or procedure for record keeping and records showing that each container of waste is certified as having met the waste acceptance criteria of the facility to which it was transferred and the certification statement is supported by additional records regarding the waste source, characterization, and container.

Supplemental References:

1. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. J.(2) Certification Before Transfer. Transuranic waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

Objective:

The objective of this requirement is to ensure that waste meets the acceptance requirements of the storage, treatment, or disposal facility before it is transferred to prevent transferring waste that

could endanger receiving facility personnel, and to avoid the delay and potential hazards associated with corrective actions taken to remedy non-compliant conditions.

Discussion:

The waste certification requirements above address development, implementation, and content of a waste certification program. The requirement that waste be certified before transfer ensures that the program is effective in preventing the transfer of waste that does not meet the waste acceptance criteria of the facility receiving the waste for storage, treatment, or disposal. In accordance with this requirement, waste should be released for transfer to another facility only after there is a certification by an authorized official that the waste acceptance requirements have been met. Ensuring certification occurs prior to allowing the physical transfer of waste prevents potential hazards associated with managing waste rejected by the facility to which it is transferred. Requiring certification before waste is transferred also reduces the likelihood of having to recall a waste shipment due to a discovery by the certification official, after the waste is in transit, that the waste does not comply with the waste acceptance requirements. Guidance on DOE M 435.1-1, Section III.K discusses what constitutes a transfer, and can be consulted to determine when this requirement needs to be met.

Certification that the waste is ready for transfer and meets the waste acceptance criteria and the applicable transportation requirements, is a control point in the transfer process. The procedures controlling waste transfer should not allow the transfer to occur unless the certification statement has been signed. Once signed, the certification statement becomes part of the record for the transfer of the waste (see Waste Transfer, Section III.K). An example of a certification statement for shipment of contact-handled waste to WIPP is included as Figure III.J.1. As can be seen from examination of the certification statement in Figure III.J.1, the signature on the certification statement is confirming that the waste has been characterized for physical, chemical, and radiological characteristics, properly packaged, and necessary container markings and shipping data have been prepared.

> *Example: Central Waste Management Facility personnel are responsible for receiving waste, providing interim storage, and making transfers to an offsite transuranic waste storage facility. In order for the workers at the Central Waste Management Facility to place a waste container on a truck for transfer, the operating procedures for the facility require that they have a signed certification statement that correlates to the container(s) (either bar coded or numbered). Once a waste container is loaded, a copy of the certification statement is included in the waste transfer papers and another is included in the Central Waste Management Facility files.*

Compliance with this requirement is demonstrated by the presence of a certification program which includes procedures requiring a signed certification statement prior to the release of waste for transfer, and by dated records showing that waste was certified before being transferred.

Supplemental References: None.

III. J.(3) Maintaining Certification. Transuranic waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Objective:

The objective of this requirement is to ensure that certified waste is managed to maintain the certification status and avoid the unnecessary handling of waste containers that would be necessary for recertifying waste.

Discussion:

There may be instances where waste must be stored before being transferred to the next stage in the waste management process. If waste is certified as meeting the waste acceptance criteria of the receiving facility prior to, or during storage, it needs to be stored and controlled so that the certification remains valid until the waste can be transferred. For instance, many DOE sites will send transuranic waste to WIPP for disposal. If a facility certifies waste in accordance with a program authorized by the Carlsbad Area Office, the waste needs to be stored under conditions and with controls to protect it from physical damage, and to prevent tampering (i.e., placement of unallowed materials into the container) so it can be transferred for disposal without re-certification.

> *Example: A facility generates transuranic waste which is sent to an onsite storage facility. An inventory of everything put into the waste container is maintained while the container is being filled. Once filled, the container is closed and a numbered tamper-indicating device is put on the container closing band. The facility's authorized waste certification official confirms that the waste has been properly characterized and meets the storage facility's waste acceptance criteria. When the authorized waste certification official fills out the waste certification statement, the number of the tamper-indicating device is also entered on the form. Facility procedures require closed, certified waste packages to be staged in an indoor area adjacent to the loading dock. Thus, at the time of transfer, the generating and receiving facility personnel are assured that the certification is valid because environmental conditions have not affected the*

package (it has not been exposed to precipitation, freezing, or extreme heat/sunlight) and because the tamper indicating device indicates that the container has not be opened since it was certified.

Also, certifying officials need to be aware of any limitations on the amount of time a waste can be stored without invalidating the certification. Actions necessary to certify a waste that involve potential radiation exposure of workers are deferred, if possible, until there is a reasonable expectation that the waste can be transferred to the receiving facility within the time that the certification is valid. Routine monitoring required for waste in storage may not allow all activities that could result in worker exposure to be deferred.

This requirement is not to be interpreted in a manner that interferes with a facility performing a normal acceptable waste management function. Therefore, if a waste is certified as meeting the waste acceptance criteria of a treatment facility, the requirement to maintain the certification of the waste is not intended to prevent the treatment facility from treating the waste. Even though, treating the waste will not "maintain" the certification, the purpose of the certification is to ensure the waste can be safely accepted for treatment. Maintenance of the certification status is intended to cause the waste to be stored, transported, and staged at the treatment facility in a manner that will allow personnel to treat the waste without concern that it no longer meets the acceptance criteria. In addition, despite the protection provided for the waste, sampling prior to treatment may still be a necessary process control step.

Specific requirements for protecting the certification status of a container of waste are generally negotiated with the receiving facility. Requirements to be considered include protecting the waste container, preventing unauthorized introduction of material into the waste, and protecting the data about the waste container. The Waste Transfer requirements (DOE M 435.1-1, Section III.K) also address protecting waste containers and data to ensure that characterization and packaging data remain accurate and useable by waste managers. Waste containers need to be provided with sufficient protection from the elements (e.g., precipitation, wind, flooding, excessive heat) such that the character of the waste and container, and therefore the certification are not altered. Containers of waste also need to be stored in a manner that prevents modifying their contents (e.g, under lock and key or with a tamper indicating device) and in a location where the container will not be damaged (away from equipment high traffic areas where there is the possibility of damage). In addition, it is necessary to be able to relate each container of waste to information about the contents of the container. Container markings must be protected from defacement or removal, and records regarding container identification and contents must be safely stored.

Example: Department personnel have learned from experience that below-ground storage does not provide the type of protection that could be relied on to protect the certification status of the waste. Although the below-ground environment maintains waste packages within a reasonable temperature range, it also subjects them to

environmental conditions that can be detrimental to packaging and marking. Condensation collecting under plastic has been shown to lead to rust of waste containers making markings illegible and the container no longer suitable for performing its containment function.

Compliance with this requirement is demonstrated by the existence of a program or procedure reflecting this requirement and site personnel able to show that the storage of containers of waste is in a facility or manner where the containers are not damaged by normal weather events, and cannot be accessed by unauthorized personnel. Further, each container can be traced to its certification and the information supporting that certification.

Supplemental References:

1. CAO, 1997. *Generator Site Certification Guide*, Revision 1, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1997.

2. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

CH-TRU WASTE CERTIFICATION STATEMENT

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Container ID Number: ____________________

CRITERIA	LIMITS	INITIALS
Container Description	• DOT Type A 55-gallon drums or solid waste boxes (SWBs)	
Container/Assembly Weight	• 1000 lbs/55-gallon drum • 4000 lbs/SWB • TRUPACT-II weight limits	
Removable Surface Contamination	• 20 dpm/100 cm^2 alpha • 200 dpm/100 cm^2 beta-gamma [4]	
Container Marking	• Bar code • Shipping category [1]	
Filter Vents	• Payload containers vented	
Liquids	• No liquid wastes • < 2 liters total residual liquid per 55-gallon drum • < 8 liters per SWB • < 1 in. (2.5 cm) in the bottom of any container	
Pu-239 FGE	• < 200 g/55-gallon drum • < 325 g/SWB • < TRUPACT-II limits	
Pu-239 Equivalent Activity	Untreated Waste • 80 PE-Ci/55-gallon drum • 130 PE-Ci/SWB • 1800 PE-Ci/55-gallon. Drum overpacked in SWB or TDOP Solidified/Vitrified Waste • 1800 PE-Ci/55-gallon drum	
Contract Dose Rate	• 200 mrem/hr	
Thermal Power	• Reported if > 0.1 watts/ft^3 • < 40 watts per TRUPACT-II	
TRU Alpha Activity	• > 100 nCi/g of waste matrix	
Pyrophoric Materials	• < 1% Radionuclide pyrophorics • No non-radionuclide pyrophorics	
Mixed Waste	• Characterization per QAPP • Limited to EPA waste codes listed in WAC	
Chemical Compatibility	• Chemicals allowed by the CH-TRAMPAC	

Figure III.J.1. Example Waste Certification Statement

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CRITERIA	LIMITS	INITIALS
Hazardous Constituents	• Target analytes and TICs reported per QAPP	
Explosives, Corrosives and Compressed Gasses	• None present	
PCBs Concentration	• < 50 ppm	
Decay Heat[1]	• Wattages listed in CH-TRUCON	
Flammable VOCs	• 500 ppm in container headspace	
VOC Concentration	• Limits shown in WAC Table 3.5.3.3	
Aspiration[1]	• Times shown in CH-TRUCON tables	
Shipping Category[1]	• Content codes listed in CH-TRUCON • One category per TRUPACT-II	
Confinement Layers[1]	• Liner punctured/vented • Number of layers known • Bags closed by approved methods • Sealed containers > 4 liters prohibited (except for waste material Type II.2)	
Acceptance Data	• Auditable package of data with signed Certification Statement on file • WWIS data transmitted	
RCRA Data	• Waste Stream Profile Form • Uniform Hazardous Waste Manifest[2] • Land Disposal Restriction notification[2]	
Shipping Data	• TRUPACT-II Payload Container Transportation Certification Documents • Bill of lading[3]	

NOTES: (1) Applies to TRUPACT-II payload control only
(2) Applies to mixed wastes only
(3) A Uniform Hazardous Waste Manifest may be substituted
(4) May be 1000 dpm/100 cm^2 for certain isotopes

I hereby certify that I have reviewed the data for this waste container and that it is complete and accurate to the best of my knowledge. I have determined that it meets the requirements stated in the current revision of the WIPP Waste Acceptance Criteria. I understand that this information will be made available to regulatory agencies and that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Waste Certification Official Signature ____________ Date ____________ Initials ____________

Figure III.J.1. Example Waste Certification Statement (cont.)

III. K. Waste Transfer.

A documented process shall be established and implemented for transferring responsibility for management of transuranic waste and for ensuring availability of relevant data. The following requirements are in addition to those in Chapter I of this Manual.

Objective:

The objective of this requirement is to ensure that the responsibility for transuranic waste containers is established, maintained, properly transferred, and adequately documented so that ownership, and therefore responsibility for safe management, of waste is clear. This responsibility includes maintaining the waste characterization information, the container information, and information about the treatment, storage, transportation and disposal status of containers of waste. This responsibility also includes an assurance that the container of waste has not been altered in a manner that affects its certification status or the ability of the waste to be properly managed.

Discussion:

As discussed in Section I.2.F.(7) of the guidance for DOE M 435.1-1 Chapter I, the radioactive waste generator program includes consideration of the generation planning, characterization, certification, and transfer of transuranic waste. In the generator's program, initial responsibility is assigned for containers of transuranic waste and a documented process for transferring the responsibility is established.

In the development of DOE O 435.1 and DOE M 435.1-1, maintaining the integrity of waste containers was identified as necessary for the proper control and safe management of transuranic waste. Similarly, maintaining information about containers of transuranic waste (characterization and container data) was recognized as vital to making and executing safe management decisions. In order to ensure that it is clear who has the responsibility for protecting the integrity of each container of transuranic waste and associated waste and container data, there needs to be one person who is identified as being responsible for the waste at any time. Confusion over who is responsible for specific waste containers is avoided by documenting the transfer of responsibility.

This requirement is similar to the concept of "chain of custody" used in sample management. As with samples, transuranic waste containers may be the responsibility of many different organizations during their management life cycle. At any point during the life cycle management of the waste, the identity of the individual responsible for each container of waste needs to be explicit. By clearly identifying the "owner" of each container of waste, there is no question regarding who is responsible for protecting the waste container and the waste characterization and

container data, and for moving the waste to the next phase of waste management (i.e., storage, treatment, or disposal).

Maintaining Waste Container and Data Integrity. The individual responsible for a container of waste is responsible for maintaining and protecting both the integrity of the container of waste and the data about the container of waste. Protecting the integrity of the waste container is the same as protecting the certification status of a waste container as discussed in the Waste Certification guidance. Essentially it involves managing the container of waste so that it is not damaged or does not degrade because of the conditions under which it is managed.

Maintaining the data about the container of waste involves ensuring receipt or traceability, or developing (as discussed below) information necessary to support subsequent waste management activities, or clearly documenting and ensuring that the information is stored and updated so that full and accurate information is available to the next individual to whom the waste is transferred.

Transferring Responsibility. The transfer of responsibility for containers of waste and the associated waste and container data is to be done in accordance with procedures at each of the facilities involved. The facility from which the waste is transferred, typically establishes (for newly-generated waste) or possesses (for stored wastes) a record or data package about the waste and its container. The facility operating procedures should require the development of an ownership log sheet similar to a "chain-of-custody" log. This log becomes part of the data package that is transferred with the container of waste. Upon transfer, the facility transferring the waste is responsible for ensuring personnel at the facility to which the waste is being transferred have assumed responsibility for the waste. A signed and dated copy of the ownership log sheet can serve this purpose. All subsequent transfers, e.g., from storage or treatment facilities, are to be in accordance with procedures requiring the transfer of the data package and documentation of the transfer of responsibility for the waste.

Procedures at the storage, treatment, or disposal facility should require the receipt of certain information about any waste which is received. To ensure that they have sufficient information to safely manage the waste and to transfer the waste to a subsequent waste management facility (if appropriate), it is important for storage, treatment, and disposal facility personnel to ensure they are provided information about the containers of waste for which they become responsible. The receiving facility requires the following documented information be available for all waste they expect to receive:

- Responsible individual. The name, title, affiliation, and phone number of each person who has held responsibility for the waste, starting with the generator. This listing can serve as the ownership log with each person signing the log upon accepting responsibility for the waste.

- Transfer dates. The date the transfer was accepted by each new "owner" of the waste.

- Waste container information. Information about the container (see guidance for III.K.(2) in this section).

- Characterization information. Information about the waste. See guidance on Waste Characterization.

- Physical location. The site and name (e.g., unique identifier such as a building number) of each location where the waste was managed.

- Previous transportation. Dates of transportation and names of carriers.

- Certification status. A signed certification statement or equivalent (see guidance on Waste Certification). Only the certification statement for the facility to which the waste is being transferred must be part of the waste package data. Previous certification statements may be included if they serve the purpose of documenting other data that should be part of the data package (e.g.,container or characterization data).

- The planned disposition of the waste. Expected storage, treatment, and disposal. See guidance on Generation Planning and Site-Wide Radioactive Waste Management Program.

For each transfer of waste, beginning with the generator, the receiver of the waste is responsible for obtaining the proper information from the sender of the waste. The receiver is responsible for ensuring receipt or availability of complete and accurate information concerning containers of waste. The information needs to be reviewed prior to actual transfer and is a condition of acceptance by the receiver.

Example: A treatment facility receives transuranic waste for processing. Upon signing for receipt of the waste, the facility manager becomes the individual responsible for the waste. Facility procedures require that a copy of the data received from the generator be kept in a file cabinet which is accessible only to one individual on each shift. As the containers of waste are processed in the facility, information is recorded in a log and the data package is updated to reflect the change in status of the waste. Upon completion of the processing, the treated waste is packaged in new waste containers and a certification statement is generated indicating that the treated waste meets the waste acceptance criteria for the storage facility to which it will be shipped. Before the waste is transferred, the treatment facility personnel provide a complete set of data to the storage

facility personnel. The data package reflects the new container numbers for the treated waste, but includes the data on the original containers received at the treatment facility. The treatment facility also keeps a duplicate copy of the data package which includes a copy of a waste log indicating transfer of ownership to the storage facility.

The responsibility for ownership of the waste can be different than that for waste certification. The individual responsible for the waste does not necessarily have to be the same individual that certifies the waste is ready to be transferred (see guidance on Waste Certification). As indicated above, the certification status is one piece of information that is transferred with the waste.

Compliance with this requirement is demonstrated if facilities have procedures for the receipt of waste and the transfer of waste, as appropriate, which address the acquisition of waste and container data and the transfer of ownership, respectively. Further evidence of acceptable performance is facility records showing that data on the waste containers are available and accurate, and that documented transfer of responsibility occurs.

Supplemental References:

1. EPA 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, 3rd Edition, U.S. Environmental Protection Agency, Washington D.C., June 1997.

III. K.(1) Authorization. Transuranic waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Objective:

The objective of this requirement is to ensure that shipments or transfers of transuranic waste are made only with the cognizance and approval of personnel at the facility receiving waste so that preparations can be assured for its safe management.

Discussion:

As discussed in the guidance for DOE M 435.1-1, Section I.2.F.(7), the radioactive waste generator program includes consideration of the generation planning, characterization, certification, and transfer of transuranic waste. During the development of DOE O 435.1 and DOE M 435.1-1, a review of waste management functions indicated that the receipt of waste without personnel at the facility receiving the waste having knowledge of what was sent presented a potential hazard. If waste is transferred to a facility without prior authorization, the controls

necessary for the proper and safe management of the waste may not be in place. As a consequence, the waste may be rejected and returned to the sender. This requirement represents a control to minimize the potential for exposures and releases during the handling and transfer of transuranic waste.

Safe transfer of the waste can only be assured if the facility receiving the waste for storage, treatment, or disposal has considered the acceptability of the waste versus its safety operating constraints. Personnel at a storage, treatment, or disposal facility who authorize the transfer of waste are indicating that they have the capability to receive the waste and manage it in a manner that is protective of workers, the public, and the environment. Therefore an essential component to safe life-cycle management is that authorization be received before transfer of transuranic waste to a storage, treatment, or disposal facility. Meeting this requirement is the responsibility of the organization or individual transferring (sending) the waste. The following are considered transfers:

(1) Waste is physically moved from one location to another, even if ownership does not change.

(2) Waste is physically moved from one location to another and ownership changes.

(3) Waste is not physically moved, but ownership changes.

The actions and documentation necessary to obtain authorization will depend on the specific storage, treatment, or disposal facility to which waste is to be transferred. In some cases, the submittal of a waste stream profile which provides a description of the waste and a range of the waste characteristics, augmented by conversations with the generator, may provide enough information for the storage, treatment, or disposal facility staff to be confident that they can safely manage the waste. In other cases, the waste acceptance requirements of the storage, treatment, or disposal facility may dictate that an onsite visit and review of the generator's waste certification program be performed. In order to expedite the transfer of waste, staff responsible for sending the waste need to ensure they understand what information and activities need to be completed in order to receive transfer authorization.

Authorization to transfer waste is received in writing and states the scope of the authorization. The authorization may specify a specific group of waste packages or specific number of shipments of a particular waste type. However, it is acceptable for the written authorization to specify a waste stream(s) which the generator can send on a routine basis. Any additional conditions or notification requirements can be included in the written authorization. Whereas it is the responsibility of the storage, treatment, or disposal facility to prepare the written authorization, the organization sending the waste must not transfer waste until they have authorization and understand which waste is included in the authorization.

Example 1: An activity at Site X results in the routine generation of transuranic waste in the form of contaminated personnel protective equipment, swipes, plastic sheeting, and paper waste. The waste stream is designated by the number X-2156. Consistent with site procedures, the generator prepares a waste stream profile which describes the characteristics, packaging, and projected generation rate of the waste stream and provides it to the waste management organization. The waste management organization reviews the waste stream profile and calls the generator facility representative to clarify the information on the waste stream profile. The waste management organization has previously reviewed the generator's certification program. Based on the certification program and the waste stream profile, the waste management organization prepares a letter authorizing the generator to transfer any waste that meets the X-2156 profile until further notice. The authorization letter also states that the generator must provide the waste management organization notice of the number of waste containers to be transferred 48 hours before a transfer occurs.

Example 2: A site plans to ship transuranic waste to WIPP for disposal. A Generator Site Certification Guide (DOE/CAO-95-2119) has been prepared to aid individual sites in their preparation to become authorized certifiers of waste destined for WIPP. Generator sites are authorized by WIPP to certify waste for transfer following an audit confirming satisfactory implementation of certification requirements. The authorization is typically good for one year, at which time the transferring facility must be re-authorized through an audit. Once the generator's certification program has been audited and found to be acceptable, day-to-day authorization of waste transfers is accomplished by review and approval of data packages describing planned waste transfers.

When transuranic waste is transferred (moved from one location to another), but the ownership of the waste does not change (i.e., the same individual is responsible for both facilities), a separate authorization may not be required. Recognizing that the intent of this requirement is to ensure that the waste is expected and can be safely managed at the facility to which it is being transferred, other documentation can serve as the written authorization.

Example: The manager of the waste management organization is the official responsible for authorizing transfer of waste to either of two separate storage facilities, Building A and Building B. Even though the waste acceptance criteria are the same for the two facilities, waste is accepted and logged into each facility separately. The manager decides to consolidate all of the waste into Building A for more efficient management. The authorization to transfer is provided by the certification statement indicating that the waste meets the Building A waste acceptance requirements, and the documentation of the new storage location on the waste characterization and container data.

Compliance with this requirement is demonstrated by sites having procedures that require a confirmation of authorization before releasing waste for transfer, and records showing that transfers are made in accordance with written authorizations.

Supplemental References:

1. DOE/CAO, 1995. *Generator Site Certification Guide*, DOE/CAO-95-2119, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, 1995.

III. K.(2) Data. Waste characterization data, container information, and generation, storage, treatment, and transportation information for transuranic waste shall be transferred with or be traceable to the waste.

Objective:

The objective of this requirement is to ensure establishment and maintenance of information about the characteristics of waste and the waste containers to ensure that sufficient information to support management of waste in a manner that is protective of workers, the public, and the environment is always available.

Discussion:

The *Radioactive Waste Management Manual*, assigns the Field Element Manager the responsibility of ensuring development and approval of a program that addresses the responsibilities of waste generators (DOE M 435.1-1, Section I.2.F.(7)). The generator requirements are to address hazards associated with a waste management facility receiving unexpected volumes or types of waste, or receiving waste that may not meet the applicable waste acceptance requirements. Generator requirements address generation planning, waste characterization, waste certification, and waste transfer. The requirement for traceability of data addresses the hazards associated with transferring waste without providing or maintaining adequate information about the container and its content. Establishing and maintaining the identity of the waste, as well as maintaining controls based on the waste's hazards, are necessary for its safe transfer and subsequent management. Acquisition of information about the waste is addressed in the guidance on Waste Characterization (DOE M 435.1-1, Section III.I). Certification that waste is ready for transfer (i.e., meets the waste acceptance requirements and transportation requirements) is discussed in the guidance on Waste Certification (DOE M 435.1-1, Section III.J). Maintenance of documentation regarding transfer of waste is discussed later in this section of guidance.

In the process of developing DOE O 435.1 and DOE M 435.1-1, transfer was identified as the activity in the life-cycle management of waste with the greatest potential for loss of information about containers of waste, and the associated loss of adequate waste management controls needed to avoid exposure or release of radioactivity. Therefore, when waste is transferred, the waste characterization and container data must be transferred or available to the new "owner" (i.e., responsible waste manager) of the waste.

> *Example: A liquid transuranic waste is being transferred to a treatment facility for solidification. The waste was characterized and the waste characterization information listed on the waste certification statement. Although the waste met the waste acceptance criteria for the treatment facility and an authorization to make the transfer was granted, the characterization information was not transmitted before or in conjunction with the waste transfer. Due to storage limitations at the treatment facility, the drums of waste were placed in an unheated staging area. After a three days of below freezing weather, it was noted that the drums were bulging and split. Had the characterization information been documented and transferred with the waste, treatment facility personnel would have known it was an aqueous waste and would have imposed controls on the waste to protect it from freezing conditions.*

Sufficient information about the container in which waste is packaged needs to be provided to the storage, treatment, or disposal organization to which waste is transferred to ensure that the containers are handled safely.

The information about the container is supported by and traceable to the more detailed container procurement information. The organization that procures the container is responsible for properly documenting the essential information regarding the procurement. The information needs to be maintained so questions about adequacy of the container for its originally intended or alternate uses can be assessed and to answer questions about subsequent procurements. Information documented concerning the procurement of waste containers includes:

- Purpose of the container;
- Container performance requirements;
- Purchase specifications; and
- Manufacturer certifications verifying performance to purchase.

The information concerning the purpose of the container should include the designed service life, the environments for which the container was designed and is compatible with, and other information necessary to allow proper use of the container. The procurement information

includes vendor information, product specifications, lot or serial number information, and other procurement information necessary to document the container purchased.

The detailed procurement data about containers can be, but does not have to be, transferred at the time waste is transferred. An acceptable practice for the organization transferring the waste would be to maintain the records for as long as they are retrievable and can be correlated to the waste containers.

The type of container information that should be provided upon transfer of containers of waste will depend on the type of waste and subsequent waste management steps. Typically, the information includes the following:

- container size and type - generally this would be the container that is providing the primary containment of the waste (e.g., DOT 7A 55-gallon drum, standard waste box, or DOT 7A 80-gallon overpack);

- container enhancements - additional items that have been added to the primary container to facilitate container performance (e.g., shielding, liners, plastic bags, absorbents);

- lifting limitations - allowable and/or unallowable lifting points and methods; and

- load limitations - based on the physical characteristics, the maximum number of containers or weight that can be placed on top of the waste container.

When waste is initially placed in the container, the organization packaging the waste is to document and manage the information regarding its characteristics (e.g., radioisotopic inventory, total activity, radiation dose, waste form). When the container of waste is physically transferred or the ownership has changed, the information regarding the waste and container must be provided or made available to the organization that acquires responsibility for the waste. A transfer is considered to have occurred if the waste is physically moved from one location to another or if there is a change in responsibility for the waste.

The following waste container characterization data are typically provided with the transfer of transuranic waste:

- physical and chemical description of waste (use of item description code or waste stream identifier, if applicable);

- radiological inventory (see guidance on Waste Characterization);

- gross weight;
- volume percent utilized;
- fissile gram equivalent;
- fixed and removable surface contamination (alpha and beta/gamma);
- surface dose rate;
- seal number;
- TRUCON Code;
- thermal power; and
- shipping category.

Example: Building 2000 is undergoing a facility cleanout that involves the decontamination of building surfaces and the removal of excess processing equipment. The organization responsible for the facility identifies two types of waste containers to be used, 55-gallon drums for small items, personnel-protective clothing, and contamination control waste, and standard waste boxes for larger pieces of equipment. The job is managed such that one operator is responsible for logging each piece of waste put into the containers. Upon filling a waste drum or box, the container is closed, and a tamper-indicating device is installed. Radiological Services personnel perform radiological surveys of each container of waste and record the data. The authorized waste certification official uses the data recorded on the waste log and survey sheets, supplemented with radiological characterization data, weight data, and other information to fill out a waste certification checklist. The checklist requires identification of waste container data as discussed above. In accordance with site procedures, the checklist is a piece of required paperwork that is to be provided to the storage, treatment, or storage facility to which the waste is transferred.

This requirement needs to be implemented with consideration given to documentation requirements imposed by other internal programs or external organizations such as the Environmental Protection Agency or Department of Transportation. These other documentation requirements, such as an EPA Uniform Hazardous Waste Manifest or a transportation bill of lading, may include much of the waste container information that is provided to the storage, treatment or disposal facility to which waste is transferred. Therefore, to the extent these other documents have the appropriate information, they may be used to meet the requirement to convey

information about the waste being transferred to a subsequent waste management facility. If documentation prepared to meet requirements of other programs or organizations is used, it may need to be supplemented to provide any additional data on waste characterization and packaging addressed in this guidance.

Example: Transuranic mixed waste is being sent from one site to another for storage. Since the waste is regulated under RCRA, a Uniform Hazardous Waste Manifest is prepared as required by 40 CFR Part 262. The manifest includes information about the physical and chemical characteristics of the waste, the container type, and container weight. The site has developed a 'Radiological and Supplemental Characteristics Data Sheet' to provide additional information about the containers of mixed waste. The data sheet provides additional information about the radiological inventory, surface dose rate, surface contamination, fissile material content, number of the tamper-indicating device installed on the waste containers, load limitations, and handling limitations. Between the two documents the storage facility is provided enough information so they can safely manage the waste.

Compliance with this requirement is demonstrated if there are procedures requiring that characterization and container data be provided and maintained for each waste transfer and documented records of transfers show that the information is being provided.

Supplemental References:

1. EPA. *Standards Applicable to Generators of Hazardous Waste*, 40 CFR Part 262, U.S. Environmental Protection Agency, Washington, D.C.

III. L. Packaging and Transportation.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Packaging.

(a) Transuranic waste shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste is removed from the container.

(b) Vents or other mechanisms to prevent pressurization of containers or generation of flammable or explosive concentrations of gases shall be installed on containers of newly-generated waste at the time the waste is packaged. Containers of currently stored waste shall meet this requirement as soon as practical unless analyses demonstrate that the waste can otherwise be managed safely.

(c) When transuranic waste is packaged, defense waste shall be packaged separately from non-defense waste, if feasible.

(d) Containers of transuranic waste shall be marked such that their contents can be identified.

Objective:

The objective of these requirements is to ensure that when waste is packaged, the container selected is adequate to contain the waste and limit radiation exposure for the entire time the waste is in storage, to reduce future exposure by segregating defense and non-defense wastes, and to ensure that the container can be correlated to necessary information on its contents. The first subrequirement is to ensure the selection of a container for waste based on the life cycle of the waste so that there will not be unnecessary repackaging of waste. The second sub-requirement is to prevent the build-up of pressure or concentrations of gases that could cause a loss of waste confinement. The third subrequirement is to ensure the segregation of defense waste that can be accepted for disposal at WIPP from other waste in order to facilitate compliance with the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended. The last subrequirement is to ensure that it is possible to identify the contents of the container of waste during storage and when the waste is removed from storage for treatment or disposal without having to open the container.

Discussion:

The need for packaging requirements specific to waste management evolved from the development of DOE O 435.1, and past experience in transuranic waste transportation. The safety and hazards analysis conducted in support of the Order and Manual development identified loss of confinement of a waste container as a potential hazard affecting worker safety and releases to the environment. In addition, the inability to associate a container with data on the contents was identified as a situation that would result in unnecessary worker exposure due to the need to re-characterize the waste. Mitigation of each of these concerns can be achieved through proper packaging and compliance with the requirements of this section. The safety analysis supporting use of the TRUPACT II for transportation of transuranic waste has identified the build up of explosive gases as a potential problem.

An analysis of existing requirements affecting the packaging of waste identified the Department of Transportation (DOT) regulations and the DOE Orders, DOE O 460.1A and DOE O 460.2, as sources of packaging requirements (see DOE M 435.1-1, Section I.D.(12)). Generally, the DOT requirements apply to offsite shipments. *Packaging and Transportation Safety* (DOE O 460.1A) invokes the DOT requirements, or documented requirements providing equivalent safety, for onsite shipments. These regulations require the use of DOT Type A or Type B packaging (depending on radionuclide content) for DOE waste shipments. The DOE O 460.1A also establishes the means and approval authority for qualifying packaging as Type A or Type B. *Departmental Materials Transportation and Packaging Management* (DOE O 460.2) includes DOE policies and requirements that supplement the DOT regulations. Requirements from DOE O 460.2 relevant to waste packaging include the inspection of waste shipments upon receipt, provision of data to the Department's Packaging Management Plan, and performance of routine assessments of transportation and packaging operations.

While the DOT regulations and DOE packaging and transportation requirements were considered adequate for shipping waste, they were not considered sufficient to address the other transuranic waste management concerns associated with long-term storage or with selecting and packaging waste based on the entire waste management life cycle.

The life-cycle management of transuranic waste has historically involved the packaging of transuranic waste followed by a protracted storage period while awaiting disposal. Selection of a container (i.e., a receptacle and any other components or materials necessary for the receptacle to perform its required containment function) needs to account for all waste management steps expected prior to and including disposal. Therefore, the container needs to meet the requirements for transportation, storage, and eventual disposal (to the extent the disposal requirements are known). Alternatively, if waste treatment is required, the container needs to be adequate to contain the waste during storage and allow the waste to be transferred to the treatment facility where it may be removed from the container prior to treatment. Subsequent to treatment,

packaging of the treated residues is based on meeting all of the requirements of the remaining waste management steps. Selection of a container that fulfills the needs of all subsequent waste management actions ensures waste confinement and eliminates the need to repackage the waste, thus avoiding potential exposure to workers.

> *Example: The Waste Acceptance Criteria for the Waste Isolation Pilot Plant (DOE/WIPP-069) identifies the container, packaging, and transportation requirements that must be met before transuranic waste may be shipped to and disposed in WIPP. The requirements are derived from several sources which include: the WIPP Safety Analysis Report, the TRUPACT-II Safety Analysis Report for Packaging, the RH-TRU 72-B Cask Safety Analysis Report for Packaging, and the WIPP Land Withdrawal Act of 1992, as amended. Containers that meet the WIPP Waste Acceptance Criteria and the acceptance criteria for storage would be acceptable since the waste would likely not require repackaging for any of the expected waste management steps.*

Containment and Protection. Transuranic waste must be adequately contained, and the container protected from conditions that could cause container degradation. Inadequate containers or container degradation could lead to failure and result in the spread of contaminated materials, worker exposure, or the non-acceptance by a receiving facility. When selecting transuranic waste containers, consideration must be given to the conditions to which the container will be subjected. If waste is to be stored outside for an extended period and subjected to the natural environment, the container must be made of materials that have been demonstrated to maintain integrity during these conditions.

> *Example: Contaminated soil and debris were packaged in wooden boxes or carbon steel 55-gallon drums which were stored in earthen berms for many years. The boxes and drums degraded to the point that they no longer served as containment and were literally falling apart. Due to the selection of inadequate containers (for the storage conditions and duration), the waste had to be repackaged prior to transfer and the used wooden boxes and drums also managed as transuranic waste.*

Transuranic waste must not be incompatible with the container in which it is placed. The physical, chemical, and radiological attributes of the waste need to be considered when selecting a container. Container integrity must not be jeopardized due to the size, shape, or weight of objects contained in the waste. Containers need to be compatible with any unusual chemical characteristics, water content, and pH of the waste. If absorbent or other materials are used to bind liquids contained in the waste, the resultant waste matrix must not be capable of spontaneous combustion, decomposition, explosion, liquid desorption, or otherwise have the ability to affect the integrity of the containers in any way (see Storage guidance III.N).

Shielding may also be required to provide protection to workers who handle the waste containers or who are responsible for monitoring waste in storage. The necessity for shielding should be

considered at the time of packaging so that the shielding can be integrated into the waste container before waste is present if internal shielding is acceptable to the storage, treatment, or disposal facility. Alternatively, the storage configuration may be designed to provide the necessary shielding. If shielding is required, consideration needs to be given to the use of materials that do not have the possibility of becoming a mixed waste if contaminated by the radiological constituents. Guidance for DOE M 435.1-1, Section III.K discusses the selection and procurement of waste containers and the necessary information that is documented.

> *Example: A new facility generates remote-handled transuranic waste sludges with caustic properties and multiple fission products species. The container selected has been designed to withstand chemical attack from the sludge, includes sufficient absorbent to ensure there are no free liquids, and incorporates shielding. The container provides protection of workers, the public, and the environment during its intended service life.*

The anticipated service life needs to be considered when selecting a container for transuranic waste. A determination of the anticipated storage time, environment, and location (waste acceptance criteria) is essential to selecting the proper waste container. For waste that does not have an identified path to disposal, the waste container may need to be designed to remain effective for an extended and/or indefinite storage period.

> *Example: A site needs to repackage a small quantity of non-defense transuranic waste with no identified path to disposal. A policy and plan have not yet been completed for resolving the disposal issues. The selected container has been designed to last a minimum of 50 years, if stored indoors.*

When selecting containers for transuranic waste, consideration needs to be given to the full life cycle of the waste, with a goal of packaging the waste only once. The selected waste container needs to be compatible with transportation requirements and the waste acceptance criteria of the facilities expected to manage the waste. Sites have generally identified the use of the DOT-certified 55-gallon drum as the container of choice for all sized, newly-generated waste. An alternative container is the standard waste box (3.1 x 4.5 x 5.9 ft). Both 55-gallon drums and the standard waste box will fit in the TRUPACT II used to transport transuranic waste to WIPP for disposal. Sites should avoid selecting containers which allow quick containment of the waste, but are not amenable to subsequent waste management steps.

> *Example 1: A site selected a 4 x 4 x 8-ft box as the container for high volumes of miscellaneous contact-handled waste because it accommodates large amounts of waste without the need for any size-reduction. However, because consideration was not given to the entire life cycle for management of the waste, site personnel did not take into account that the box was not compatible with any approved transuranic waste disposal facility or transportation system. Consequently, in order to make the waste acceptable*

for transport and disposal at WIPP, site personnel will have to repackage the waste and may have to treat the 4 x 4 x 8-ft box as transuranic waste also.

Example 2: A requirements analysis was performed on the life-cycle plan for a specific transuranic waste stream that will generate odd-sized solid debris. The analysis indicated that a standard waste box could be used to meet all the requirements for transportation, as well as satisfy the storage and disposal facilities waste acceptance requirements.

To ensure that the waste container performs as expected, the following need to be considered when placing waste in the packaging:

- Container free of deformations or imperfections that may cause a loss of container integrity before the designed lifetime.
- Waste placement in a manner that does not adversely affect the integrity of the waste container.
- Containers utilized such that void space within the container is minimized, although care should be taken to avoid exceeding weight or other limitations identified through consideration of the life-cycle management process.
- Waste container labels and markings permanently applied.

The selection of the container is influenced by the storage conditions, storage duration, and the monitoring expected for the waste container. Ensuring waste containers provide confinement for their expected storage life is therefore dependent on ensuring an appropriate storage environment consistent with the container characteristics. Storage of waste containers is addressed in the guidance for DOE M 435.1-1, Section III.N.

<u>Vents</u>. Because of the relatively large flux of alpha particles associated with transuranic waste, there is a potential for radiolysis of hydrogen containing materials and the generation of hydrogen gases within transuranic waste containers. In addition, depending on the waste contents and/or the storage conditions, other gases, some of which are potentially flammable or explosive, may be created. To address this issue, containers of newly generated waste shall be equipped with vents or other mechanisms to mitigate the hazards associated with the evolution and accumulation of gases within a waste container. Implementing this requirement includes taking actions to address the accumulation of gases in inner containers such as bags, paint cans, and drum liners, in addition to addressing the outer container. Inner containers may be punctured, vented, or provided with products which have been proven to prevent the accumulation of dangerous quantities of gases. Outer containers can be provided with filtered vents or products which have been proven to

prevent the accumulation of gases. The installation of vents or other mechanisms on transuranic waste containers must not interfere with the container's ability to maintain waste containment until the waste is properly dispositioned (treated or disposed).

Waste currently in storage is to be provided with vents or other mitigating mechanisms at the soonest practical time unless it can be shown that vents are not needed. Implementation of this requirement does not require waste to be removed from storage solely for the purpose of installing vents since this would result in exposure which could otherwise be avoided. Instead, the intent is for site waste managers to install vents the next time the waste containers are accessed for some other purpose such as assaying, reconfiguring storage, recovering waste from earthen-covered storage, or preparing for transportation to the Waste Isolation Pilot Plant. The *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* requires the installation of vents on containers so they can be transported in the TRUPACT II.

The installation of vents on containers of transuranic waste in storage is not necessary if an appropriate analysis has been prepared that demonstrates that the unvented containers do not pose an unacceptable hazard. Application of this allowance within the requirement is dependent on an approved safety analysis report or equivalent which shows that gas generation is not credible or that the consequences are acceptable. An acceptable method of demonstrating that venting is not required is to show that, based on the waste container contents, radiological characteristics, and/or environmental factors, it is not credible to generate gases which pose a fire or explosion hazard or create conditions which would otherwise breach the containers, such as over-pressurization. In this usage, credible has the same meaning as used in safety analysis reports. If over-pressurization or generation of ignitable or explosive gases is credible or assumed to be credible, the analysis must show that the consequences of an accident are within established limits for radiation dose to workers (10 CFR Part 835) and to the public (DOE 5400.5).

The *Radioactive Waste Management Manual*, Section III.D requires the development of a radioactive waste management basis for transuranic waste management facilities, operations, and activities; this includes transuranic waste in storage as of the issuance of DOE O 435.1. In developing the radioactive waste management basis, site personnel need to consider the hazards associated with drums of transuranic waste which have not been provided with vents or been proven to not need vents through an approved safety analysis. For unvented containers in earthen-covered storage, the facility itself may mitigate the hazards associated with the accumulation of gases. For above-grade storage of transuranic waste containers, the radioactive waste management basis needs to include controls which mitigate the hazards associated with the accumulation of gases by restricting access to the storage area and providing equipment to protect against fire or explosion. Waste managers should evaluate unvented containers in storage and determine if it is appropriate to take prompt action to install vents rather than wait until the next time the waste is actively managed. Immediate action may be warranted if drums show signs of

gas accumulation (bulging) or if the waste and radiological characteristics are similar to other containers which contain waste which is known to evolve gases.

Segregating Defense Waste. Consistent with current legislation, the Department plans to dispose of defense transuranic waste at WIPP. Disposal at WIPP of only defense waste is a constraint in the *WIPP Land Withdrawal Act of 1992*, as amended. In contrast to defense waste, there are currently no planned facilities for the disposal of non-defense waste. The intermixing of defense and non-defense transuranic waste is therefore a practice that must be avoided, if feasible, so waste can be accepted for disposal at WIPP. The *Radioactive Waste Management Manual*, DOE M 435.1-1, includes a requirement (DOE M 435.1-1, Section III.G) that identification of waste as defense or non-defense must be included in facility waste acceptance requirements. Additional discussion of what qualifies as defense waste is included in the guidance for Section III.G of this document.

The language in the *Nuclear Waste Policy Act of 1982*, as amended, defines "atomic energy defense activity" to include "any activity...performed in whole or in part in carrying out...defense nuclear waste and materials by-products management" (Nordhaus). Based on this definition, the disposal of commingled defense and non-defense transuranic waste at WIPP is permissible in those cases where it is not feasible to segregate the waste. This is a result of the source of the waste being "in part" from defense nuclear waste management. The feasibility of segregating and packaging defense waste separate from non-defense waste needs to be made at the time the waste is packaged, and needs to be based on consideration of the cost and risk associated with performing the waste packaging. Waste managers must make a good faith effort to evaluate whether there is the potential for commingling defense and non-defense waste streams and whether it is feasible to segregate them prior to generating and packaging the wastes. It is inappropriate to generate and package waste without regard to the source being a defense or non-defense activity then claim that it is not feasible to segregate waste once it is commingled in a container. If the actions necessary to segregate defense waste from non-defense waste would not normally be performed and performing them would result in undue costs or risk (radiation exposure), then segregation would not be considered feasible.

Example: Site A has an examination and experimental facility which has a series of gloveboxes used for performing work on materials containing transuranic isotopes. Both defense and non-defense experiments are performed in the gloveboxes, however, generally they are not performed at the same time. A project involving the examination of materials in support of the Office of Science has been completed. Prior to commencing the next project, a general clean-out of the gloveboxes is performed in which material associated with the project, e.g., unused specimens and one-time use materials (swipes, etc.), are removed from the gloveboxes. These waste materials are packaged as non-defense waste. Various equipment and tools remain in the gloveboxes for use in subsequent experiments. Whenever there is a more thorough cleanout of the

gloveboxes, when maintenance (change-out of gloves or HEPA filters) is performed, or when failed equipment is removed, it is recognized that there is a commingling of contamination from defense and non-defense activities. However, because the waste is in part from defense activities, it is packaged and disposed of as defense transuranic waste. Similarly, when the gloveboxes are decommissioned and removed, the fact that they were used for defense program activities makes them eligible for disposal as defense waste.

Waste that is generated after issuance of DOE O 435.1 is to be identified as either defense or non-defense waste. In this usage, generated means any waste that is packaged after issuance of DOE O 435.1, including waste from processing plants, treatment plants, cleanup activities, and retrieval activities. Once identified, if feasible, the waste must be packaged separately and the containers clearly marked as to whether they contain defense or non-defense transuranic waste. Identification of waste containers as defense or non-defense can be included in machine-readable code on the container, but should also be human readable. Different categories can be distinguished through markings or labeling of waste packages or through color coding. This provides a ready indication that a waste package is eligible for disposal at WIPP because personnel involved in the transfer operation can easily see that waste containers are of the correct category in addition to having the information on records.

Example: A site that stores transuranic waste uses color coding to distinguish defense from non-defense transuranic waste. The site already uses white drums for the storage of transuranic waste, so opts to have non-defense transuranic waste drums painted with 2-inch red stripes around the drum about 12 inches from each end. In addition to the characterization documentation indicating the type of waste, the red-striped drums are easy to distinguish from the plain white drums that contain defense transuranic waste.

The Manual does not require waste containers that were previously (e.g., prior to issuance of DOE O 435.1) placed in storage in buildings or other accessible above-ground configurations to be removed from storage so they can be marked or labeled to distinguish those containing defense waste from those containing non-defense waste. In fact, such an action would be counter to one of the purposes of these requirements, namely to avoid personnel exposure attributable to unnecessary handling of waste containers. Also, it is not the intent of this requirement to segregate defense and non-defense waste that was previously commingled in a waste container. Such waste is to be considered defense waste. However, when waste containers are removed from storage for some other reason, such as preparation for transfer to WIPP, waste managers are to label or mark them as defense or non-defense and/or segregate them to facilitate future waste handling. Similarly, waste containers in earthen-covered retrievable storage configurations must be marked or labeled during the time they are recovered, assayed, and transferred to another waste management activity. If the containers of waste in earthen-covered retrievable storage have failed and the waste is determined to be transuranic, the new container provided for repackaging the waste must be marked, labeled, or color coded as discussed above.

Example: Transuranic waste is stored in drums in a dense-pack array in a storage facility. Records indicate that most of the waste is defense waste. In the process of certifying the waste for transfer to WIPP in accordance with the approved certification program, each waste container is being assayed to determine its transuranic isotope concentration. As personnel remove and assay each drum, they also apply stickers in three locations on each drum that indicate whether the waste is defense or non-defense. This determination is made based on a review of records of the programs that generated the waste. Those drums identified as containing both defense and non-defense waste are labeled as defense waste and are eligible for disposal at WIPP. When the waste containers are returned to storage, personnel segregate the containers of defense waste from those of non-defense waste.

Containers of non-defense transuranic waste are to be segregated from containers of defense waste in storage facilities in a manner that minimizes and simplifies future waste container handling. In placing waste into storage, consideration needs to be given to the timing of transferring waste containers to a subsequent waste management step. Segregation within a storage facility does not require construction of separate facilities for storing waste or even providing separate bays within a facility. Segregation can be provided by how and where the waste is placed in the storage facility and it can be delineated by lines painted on the floor, by rope barriers, or similar means. The principal concern to consider in storing waste that has been segregated as defense or non-defense is the ability to access waste for future management without having to handle other waste. Since WIPP has been identified as the defense transuranic waste repository, it is likely that waste management steps leading to transfer to WIPP will occur with defense waste on a schedule separate from actions to be taken with non-defense waste. Therefore, to the extent practical, waste should be placed in storage to allow access of the WIPP-bound waste without having to move the non-defense waste.

Marking and Labeling. The marking and labeling of waste containers need to be done in a manner that allows traceability to the documentation of the waste characteristics and container information. The marking or labeling needs to be applied such that it will be visible if the waste package is on the outside of a storage or transportation array. For a 55-gallon drum, this is generally accomplished by placing the marking or labeling about every 120 degrees around the outside of the drum. For a waste box, acceptable labeling can be accomplished by placing labels on each side of the box. Waste package identification should be in medium to low density Code 39 bar code symbology in accordance with ANSI/AIM-BC1-1195. Bar coding is to be a minimum of 1 inch high and should be accompanied by human-readable alphanumeric characters at least ½ inch high. Durability and readability of marking and labeling is one of the items included in the inspection program for waste in storage (see guidance for DOE M 435.1-1, Sections III.N and III.Q).

Example: A transuranic waste generator is packaging waste in accordance with the site certification program that successfully passed a Waste Isolation Pilot Plant Waste Certification Program audit. In accordance with the site certification procedures, labels meeting ANSI/AIM-BC1-1995 that contain the site identifier and unique identifier are placed in three locations equally spaced around each drum. This satisfies the marking and labeling requirement.

Waste characterization and the container documentation is to be associated with each individual container of waste. Guidance related to documentation is discussed in guidance for Waste Transfer (DOE M 435.1-1, Section III.K). The documentation needs to include the aspects relative to container selection including the designed service life, the environments that the container was designed for and is compatible with, and other information necessary to allow proper use of the container.

Compliance with the packaging requirement is demonstrated by procedures which document proper packaging protocols, including documented evidence that, where feasible, non-defense transuranic waste has been packaged separately from defense transuranic waste and by never having to repackage transuranic waste that is packaged after issuance of DOE O 435.1 in order to maintain containment. However, the above protocol may not be satisfied by containers that were placed in storage prior to issuance of the DOE O 435.1. For those containers, the goal is to only have to repackage the waste one time after it is retrieved and characterized. Further, acceptable performance is demonstrated by containers of waste having marking and labeling that allows correlation with waste characterization data and container information. Successful performance of this requirement is also demonstrated by a record of container performance in which failure has not routinely occurred.

Supplemental References:

1. DOE, 1995. *Departmental Materials Transportation and Packaging Management,* DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

2. DOE, 1996. *Packaging and Transportation Safety*, DOE O 460.1A , U.S. Department of Energy, Washington, D.C., October 2, 1996.

3. DOT. *Shippers-General Requirements for Shipments and Packagings*, 49 CFR Part 173, U.S. Department of Transportation, Washington, DC.

4. ANSI, 1995. *Uniform Symbology Specification,* ANSI/AIM-BC1-1995, American National Standards Institute, Automatic Identification Manufacturers, August 16, 1995.

5. CAO, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant,* Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

6. Nordhaus, 1996. Robert R. Nordhaus to Al Alm, memorandum, *Interpretation of the Term "Atomic Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act,* U.S. Department of Energy, Washington, D.C., September 9, 1996.

7. Dials, 1997. G.E. Dials to Distribution, memorandum, *Carlsbad Area Office Interim Guidance on Ensuring that Waste Qualifies for Disposal at the Waste Isolation Pilot Plant,* Carlsbad Area Office, U.S. Department of Energy, Carlsbad, NM, February 18, 1997.

8. *Waste Isolation Pilot Plant Land Withdrawal Act of 1992,* as amended, October 30, 1992.

9. *Nuclear Waste Policy Act of 1982,* as amended, January 7, 1983.

III. L.(2) Transportation. To the extent practical, the volume of waste and number of transuranic waste shipments shall be minimized.

Objective:

The objective of this requirement is to reduce the risk associated with transuranic waste management by reducing the number of miles traveled transporting waste. This is to be done by the efficient use of waste containers, minimizing the volume of waste which requires shipment, and optimizing shipping plans and schedules.

Discussion:

The need for transportation requirements specific to waste management concerns was evaluated in the development of DOE O 435.1, *Radioactive Waste Management*, and DOE M 435.1-1 the *Radioactive Waste Management Manual.* An analysis of existing requirements affecting waste transportation identified the Department of Transportation (DOT) regulations and the DOE Orders, DOE O 460.1A and DOE O 460.2 (see DOE M 435.1-1, Section I.1.E.(11)), as sources of applicable requirements. Generally, the DOT requirements apply to offsite shipments. *Packaging and Transportation Safety* (DOE O 460.1A) invokes the DOT requirements, or documented requirements providing equivalent safety, for onsite shipments. *Departmental Materials Transportation and Packaging Management* (DOE O 460.2) includes DOE policies and requirements specific to DOE that supplement the DOT regulations. Requirements from DOE O 460.2 relevant to transuranic waste transportation address development of a

Transportation Plan for high-visibility shipment campaigns (e.g., shipments to WIPP), use of the Department's Transportation Tracking and Communications System, and administrative requirements. Additionally, for waste exceeding Type A quantities of radioactive material per DOT regulations, notification of the expected date of arrival is to be given to the site to which the waste is being shipped, and if the waste is not received on the expected day, notification of the shipper is mandated.

The DOT regulations and DOE packaging and transportation requirements were considered adequate for ensuring safe transportation of the waste. However, recognizing that one of the higher risks associated with waste management is from the number of miles traveled in transporting waste, transuranic waste shipments should be minimized to reduce worker exposure, risk, and cost. This can be achieved, in part, by ensuring that all containers or primary packagings (e.g., drum or waste box) are used to capacity, and that transportation systems are efficiently utilized. Reaching the capacity (volume or weight) of the waste container should be a goal of every waste packaging operation. Containers should be filled so as to minimize headspace volume and allow closure, without exceeding its weight capacity or compromising its integrity.

> *Example 1: Miscellaneous defense transuranic waste such as personnel protective equipment, contaminated tools, and paper and plastic sheeting are being packaged in 55-gallon drums for disposal at WIPP. Site personnel use a compactor to maximize the amount of waste placed in the drum. Administrative controls ensure that drum weight limits are not exceeded.*

> *Example 2: Defense transuranic waste is being thermally treated and packaged in 55-gallon drums for disposal at WIPP. Because of the density of thermally treated waste, site personnel fill each drum to its maximum weight capacity, 1000 pounds, although excess headspace remains.*

There may be circumstances that require the use of dunnage in the form of empty drums when transporting transuranic waste. Due to TRUPACT II limits on weight, wattage, curies or dose rate, it may not be possible to include a full complement of containers with waste in a shipment. Some empty containers may have to be included in the normal 14 drums (or 7 for a half pack) which constitutes a shipment. In optimizing shipments, the amount of dunnage used is to be minimized to the extent practical.

The same goal applies to transport systems. Containers of waste should be held and accumulated until a sufficient number of packages is available to make cost-effective use of the transportation system.

> *Example: Defense transuranic waste is being thermally treated and packaged in 55-gallon drums for disposal at the WIPP. Because of the density of thermally treated*

waste, each drum is filled to its maximum weight capacity of 1000 pounds. A sufficient number of drums (7) is then accumulated at a staging area to enable full and efficient use of the Halfpack packaging for shipment to the WIPP.

The distance transuranic waste is transported, and the number of times waste is physically handled is directly related to the risk of release or exposure. As part of the planning and documentation concerning the life-cycle management of transuranic waste, the Site-Wide Waste Management Program should seek to reduce the number of times the waste is handled or otherwise transported. Site transuranic waste management programs need to ensure that both on-site and off-site transport and handling is minimized.

Example 1: A small quantity site performed an optimization study and determined the nominal volume of transuranic waste that needed to be shipped off-site for the year. Staging the waste prior to transport reduced the number of shipments and allowed the transfer of the waste to occur during the summer when road conditions were best.

Example 2: A waste management operation on a large DOE reservation generates transuranic waste that can only be fully characterized by facilities located elsewhere on the reservation. Staging the waste and transferring it during off-peak traffic hours reduced the number of shipments across publicly-traversed roads on the reservation, and helped minimize the risk to the public.

Transuranic waste transportation needs will be specific to each site. Availability of treatment, storage, and disposal capabilities, as well as funding profiles, will influence the need to ship transuranic waste. In this requirement, the term, "to the extent practical" means that site personnel have latitude in making decisions regarding what is practical for their particular situation. This requirement is not intended to force decisions that are contrary to safe waste management, regulatory compliance, or cost-effectiveness. Detailed and documented planning that provides the rationale for a waste shipment regimen is the best way to balance this requirement with site-specific realities.

Example: A site-specific evaluation was performed to support a recommendation on either building transuranic waste storage capacity or maintaining the current number of small off-site shipments. The evaluation indicated that concerns over building the storage facility outweighed the benefits of minimizing shipments and the current shipment regimen was continued. The evaluation was included as part of the Site-Wide Waste Management Program documentation.

Transportation over the nation's highways and railways results in the most direct contact between the Department's radioactive waste and the general public, stakeholders, and representatives of States, Tribes, and local government organizations. These groups are primarily concerned with

the shipment of these materials through states, cities, and neighborhoods. Efforts to minimize the volume and number of transuranic waste shipments will help alleviate their concerns.

Compliance with this requirement can be demonstrated by a combination of site procedures directing the efficient use of waste container capacity and documentation showing that transuranic waste shipments are systematically planned and make optimal use of the shipment system (e.g., TRUPACT II) to the extent practical.

Supplemental References:

1. DOE, 1995. *Departmental Materials Transportation and Packaging Management,* DOE O 460.2, U.S. Department of Energy, Washington, D.C., September 7, 1995.

2. DOE, 1996. *Packaging and Transportation Safety*, DOE O 460.1A , U.S. Department of Energy, Washington, D.C., October 2, 1996.

3. DOT. *Shippers-General Requirements for Shipments and Packagings*, 49 CFR Part 173, U.S. Department of Transportation, Washington, D.C.

III. M. Site Evaluation and Facility Design.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for transuranic waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new transuranic waste facility or expansion of an existing transuranic waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, and human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Objective:

The objective of this requirement is to ensure that natural and human environmental factors and geotechnical characteristics of proposed sites are accounted for in selecting the location and design features of new transuranic waste management facilities or significant modifications of existing facilities, and that locations are avoided if facility design cannot compensate for negative site characteristics or environmental conditions.

Discussion:

The *Radioactive Waste Management Manual* (DOE M 435.1-1, Section I.1.E.(18)) invokes the requirements of DOE O 420.1, *Facility Safety,* and DOE O 430.1A, *Life Cycle Asset Management* in site evaluation and facility design. In the development of DOE M 435.1-1, it was determined that specific attention should be given to selection of a waste management facility location with consideration given to the beneficial and detrimental aspects of the site.

Site evaluation includes the identification and characterization of potential sites (locations within a DOE reservation) for new transuranic waste management facilities or significant modifications of existing facilities. Selection of sites for DOE facilities is generally constrained to those federal lands owned and managed by DOE. Within DOE reservations, the process of selecting sites has the purpose of identifying the best location with consideration of features which are desirable for a facility.

In the context of this requirement, the environmental and geotechnical characteristics include:

- ecology - the flora and fauna that have evolved and adapted to the other environmental characteristics of the site;
- topography - the physical features of the ground surface at and around the site;
- meteorology - the normal and extreme weather events of the site;
- hydrology - the surface and ground water at the site;
- geology - the sediment and structural features of the earths crust at the site;
- seismology - the earthquake potential of the area;
- soil characteristics - characteristics of the soil that affect its load-bearing, water infiltration, and percolation;
- human activities - proximity of the public and human-induced events or feature;
- emergency services and response - proximity of services and population sheltering; and
- hazards to other facilities - proximity of existing facilities and proposed facility.

Characterization of a site is to result in collection of the data necessary to support a decision on acceptability of a site and for use in site-specific design of a facility. The site characterization and selection process will vary from one DOE site (reservation) to the next because of substantial differences in their environmental and geotechnical characteristics. Similarly, the interests of stakeholders which vary from site to site are likely to influence the issues to be addressed in site characterization and selection. The level of characterization needs to reflect application of a data quality objective-type process where the type and amount of information to be collected is commensurate with the hazards and the decisions which have to be made based on the data. The resulting site characterization program needs to include the investigations and studies needed to evaluate site and facility performance.

Natural Phenomena Hazards. The characterization of a site for natural phenomena hazards is to identify the range of normal and extreme natural events that should be taken into account in the siting and design of the facility. The amount of characterization necessary will be influenced by the hazard associated with the facility and release of the radionuclide inventory. Guidance on

characterization and consideration of natural phenomena hazard in the design of DOE facilities is contained in the following standards supporting implementation of *Facility Safety* (DOE O 420.1):

- *Natural Phenomena Hazards Characterization Criteria*;
- *Natural Phenomena Hazards Assessment Criteria*;
- *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*;
- *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*; and
- *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities.*

Example: A new storage facility is being considered at the Hanford Site. Due to the environmental setting, wind effects and seismic activity are factors that have to be considered in the design regardless of the location selected at the Site. However, due to the local topography, concerns about flooding can be addressed by selecting a location on the Site's central plateau. A similar facility is being considered at the Savannah River Site. The Savannah River Site evaluation includes the consideration of flooding and high winds in the design regardless of location. However, seismic concerns are minimal because of the region of the country; also flooding impacts can be mitigated by selecting an appropriate area of the Site.

In carrying out characterization activities, field studies need to be performed so as to not compromise the integrity of the land to be dedicated to waste management activities. This is particularly relevant to disposal facilities where improper design or installation of core sampling or groundwater sampling wells can lead to a preferential path for the migration of contaminants from a facility. Also, the characterization is to be carried out in accordance with the site's quality assurance program, including maintaining records of data collected. Documentation of the results of the site characterization program is not only needed for use in design, but may also provide information necessary for complying with requirements of the NEPA process.

Human Activities. The site of a proposed transuranic waste management facility needs to be evaluated with respect to the effects of the facility on human activities and the effect of human activities on the facility. Effects of the facility location on human activity includes consideration of:

- transportation routes;
- present and future population distribution (future population considerations should be constrained to reasonable time frames consistent with regional land use planning, not thousands of years);
- present and proposed land and water uses in the region; and
- any special characteristics that would influence the consequences of releases of radioactive material during the life cycle of the facility.

The potential impact of the waste management facility construction, operation, and decommissioning need to be evaluated, considering current and future land use plans and population distribution. Evaluation and selection of the location for a facility should ensure that there is and will remain a buffer between the facility and the public. Such considerations in site selection provide defense in depth by ensuring there is space for corrective actions to be taken if there are unplanned releases and by establishing distance for attenuation of such releases so that impacts are minimized.

> *Example: Site Z is going to construct a facility to treat remote-handled transuranic waste to make it acceptable for disposal. There are no natural environmental characteristics that make any of the proposed locations superior to others. However, one location is in the center of the site and the others are either near the current site boundary or in areas being cleaned up so they can be released from DOE control. Because the criteria for selecting a site include consideration of the proximity to current and future populations, the location near the center of Site Z is preferred.*

Another aspect of human activities is the effect that they may have on the waste management facility. Locating a facility near other facilities on or near the DOE site may impact the design or performance of the facility. For instance, a tall building may create a wake on its downwind side that would cause the exhaust effluent from a nearby, downwind facility to be dragged down to ground surface in a short distance with the potential of impacting workers or nearby members of the public. To counteract this effect, the waste management facility would have to extend its stack higher than the wake effect, or an alternative location for the facility should be considered.

Compliance with this requirement is demonstrated by performing an appropriate site evaluation for new facilities or expansions of existing facilities, and by the ensuring that the environmental and geotechnical characteristics of the site which are significant to protection of workers, the public or the environment are accounted for in selection of the site or through facility design.

Supplemental References:

1. DOE, 1989. *General Design Criteria*, DOE 6430.1A, U.S. Department of Energy, Washington, D.C., April 6, 1989 (canceled).

2. DOE 1992. *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities*, DOE-STD-1024-92, Change 1, U.S. Department of Energy, Washington, D.C., 1992.

3. DOE, 1993. *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, DOE-STD-1021-93, Change 1, U.S. Department of Energy, Washington, D.C., 1993.

4. DOE, 1994a. *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, DOE-STD-1020-94, Change 1, U.S. Department of Energy, Washington, D.C., 1994.

5. DOE, 1994b. *Natural Phenomena Hazards Characterization Criteria*, DOE-STD-1022-94, Change 1, U.S. Department of Energy, Washington, D.C., 1994.

6. DOE, 1995. *Natural Phenomena Hazards Assessment Criteria,* DOE-STD-1023-95 Change 1, U.S. Department of Energy, Washington, D.C., 1995.

III. M.(2) Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

Objective:

The objective of this requirement is to ensure that a minimum set of facility requirements and general design requirements determined from hazards analyses or policy considerations are applied to transuranic waste management facilities.

Discussion:

The facility requirements and general design criteria included in DOE M 435.1-1, Sections III.M.(2) (a) through (e), are included as requirements to ensure adequate protection of the public, workers, and the environment from nuclear hazards. The requirements contained in these sections apply to new and existing transuranic waste management facilities, unless the requirement specifies otherwise.

During the development of DOE O 435.1 and DOE M 435.1-1 an analysis of the hazards associated with the management of waste indicated that appropriate facility safety requirements and general design requirements are essential to ensuring the protection of the public, workers, and the environment. Therefore the intent is to apply these requirements to all transuranic waste management facilities, both existing and new. However, it is recognized that in some cases it may not be practical, or possible, to apply these requirements to existing transuranic waste facilities or operations. Such conditions as limited programmatic usage, expected short service life of the operation, or factors that make long-term, capital-intensive upgrades unreasonable may be bases for not applying the requirements. In such cases, an exemption to the requirement may be warranted. The Implementation paragraph of DOE M 435.1-1 provides for an exemption to a requirement provided it is processed in accordance with the requirements of DOE M 251.1-1A, *Directives System Manual.*

> *Example: At Site Z it is determined that the requirement in DOE M 435.1-1, Section III. M.(2)(e), Monitoring, for an existing transuranic waste tank is unreasonable due to the planned short service life of the tank. The existing tank is not routinely being used and would only be used over the next 18 months for emergency storage of liquid transuranic waste. A replacement for the tank is under construction. In accordance with DOE M 251.1-1A, Chapter VII, "Exemptions," an Exemption Request is prepared that supports the position that application of the requirement is not justified by any safety and health benefit. The exemption request also notes that procedures will be implemented to ensure a once per shift visual check to ensure no waste is inadvertently transferred to the tank. The Exemption Request is processed in accordance with the requirements contained in paragraph 4, Exemption Process, in Chapter VII.*

DOE M 435.1-1 also allows for the use of the "Necessary and Sufficient Closure Process" or the integrated "Safety Management System." Use of these processes for deriving facility design requirements that provide protection comparable to the requirements contained in DOE M 435.1-1, Sections III.M.(2) (a) through (e) is also acceptable at sites where these processes are invoked by contract.

Application of these requirements to all existing transuranic waste facilities may appear to contradict the direction or guidance provided by some other DOE Orders that are invoked by DOE M 435.1-1, Section I.1.E., *Requirements of Other Regulations and DOE Directives.* In such cases the requirements contained in DOE M 435.1-1 do apply.

> *Example: Section I.1.E.(18), Site-Evaluation and Facility Design, invokes DOE O 420.1, Facility Safety. Guidance to DOE O 420.1 states that the design criteria included in the Order are "applicable to the design and construction of new nonreactor nuclear facilities and for modifications to existing nonreactor nuclear facilities when modifications significantly increase the probability or consequences of a nuclear accident or require a*

change in the Technical Safety Requirements (TSRs) of a facility. The definition of 'significant' is intentionally left to the judgment of the proposing contractor and the approving DOE authority. In part, this is intended to allow upgrading of existing safety equipment or installation of minor new improvements without subjecting the process to onerous procedural requirements and thus discouraging improvements." Thus, under DOE O 420.1 an existing transuranic waste management facility that is to be "insignificantly" modified does not have to meet the design requirements of DOE O 420.1. However, under DOE M 435.1-1, the same facility must meet the design requirements of DOE M 435.1-1, Section III.M.(2) (a) through (e), or follow the DOE M 251.1-1A exemption process. The requirements contained in DOE M 435.1-1 have precedence, and should be implemented.

A "backfit" process has been discussed by the Department in the past to address changes that may be required through the imposition of a new DOE safety requirement. Such changes may be problematic for transuranic waste facilities and systems that have been in existence for over 20 years. It is not the purpose of DOE O 435.1 and DOE M 435.1-1 to create such a process for the Department; however an existing or new field-office or Program Secretarial Office backfit analysis and review process may be applied to determine whether implementation of a proposed backfit could be justified on the basis of a substantial safety improvement or on a cost-benefit basis. One example of a candidate process is contained in expired DOE N 5480.5, *Imposition of Proposed Nuclear Safety Requirements*, which expired in 1993 because of an administrative provision. Another candidate process is described Draft DPOM-FS-300, "Treatment of Proposed Backfits," which was developed for the Office of Defense Programs, but not formally adopted. A third candidate process is documented in Westinghouse Savannah River Company, High Level Waste Management Engineering Procedure, ENG. 12, "HLWMD Backfit Analysis Procedure." For development of new backfit processes Nuclear Regulatory Commission requirements in 10 CFR 50.109 and 10 CFR 76.76 should be consulted.

Compliance with this requirement is demonstrated by documentation that supports the implementation of the requirements at DOE M 435.1-1, Section III.M.2. (a) through (e), or documentation that supports the "Necessary and Sufficient Closure Process" or integrated "Safety Management System," or the DOE M 251.1-1A exemption process.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft DOE G 420.1-X, September 1995.

2. DOE, 1993. *Defense Programs Operations Manual, "Treatment of Proposed Backfits,"* Revision 0, Draft DPOM-FS-300, U.S. Department of Energy, Washington, D.C., February 5, 1993.

3. DOE, 1998. *Directives System*, DOE O 251.1A, U.S. Department of Energy, Washington, D.C., January 30, 1998.

4. DOE, 1998. *Directives System Manual*, DOE M 251.1-1A, U.S. Department of Energy, Washington, D.C., January 30, 1998.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(a) Confinement. Transuranic waste systems and components shall be designed to maintain waste confinement.

Objective:

The objective of this requirement is to ensure that the design of transuranic waste management facilities and equipment include features necessary to prevent the uncontrolled releases of radioactive materials.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the unexpected or uncontrolled release of radioactive materials at different stages of waste management were identified as potential hazards that could impact workers, the public, or the environment. The DOE M 435.1-1, Section I.1.E.(18) invokes the *Facility Safety* and *Life Cycle Asset Management* Orders, DOE O 420.1 and DOE O 430.1A, respectively, as directives applicable to the design of radioactive waste management facilities. The current requirement supplements those directives by specifically requiring that waste management systems and components of those systems be designed to maintain waste confinement.

The term "confinement" is defined as:

> "An area having structures or systems from which releases of hazardous materials are controlled. Primary confinement systems are process enclosures (gloveboxes, conveyors, transfer boxes, and other spaces normally containing hazardous materials). Secondary confinement areas surround one or more primary confinement systems (operating area compartments)."

In broad terms the purpose of waste confinement is to minimize the spread of radioactive and/or hazardous materials during normal operations, abnormal operations, and potential accidents. The

Packaging and Transportation requirements (DOE M 435.1-1, Section III.L) address confinement of solid transuranic waste in packaging. The Disposal requirements (DOE M 435.1-1, Section III.P) invoke performance-based requirements for confinement of transuranic waste disposal facilities. Therefore, the focus of the following guidance is on incorporating confinement features into the design of treatment or liquid storage systems.

The designs of confinement features should be tailored on a case-by-case basis (i.e., graded approach) based on a consideration of the quantity and form of the transuranic waste and on the conditions for potentially dispersing the contamination. For liquid waste storage or treatment, the vessels, piping, pumps, valves, etc. must provide the primary confinement. Similarly, in treatment systems for solid transuranic waste, hoods, gloveboxes, and process equipment must be designed to control the spread of contamination. Design of these systems should take into account the chemical characteristics of the materials to be managed so that appropriate materials of construction can be selected. Engineering evaluations, trade-offs, and experience should be used to develop practical designs that achieve the confinement objective. The adequacy of confinement systems to effectively perform the needed functions needs to be documented and accepted through the facility or operation safety analysis report or similar documentation.

> *Example: A treatment system for transuranic waste generates an acidic by-product waste stream. The facility is designed so that the liquid waste stream is collected in tanks in the facility, then is batch processed to meet the disposal facility's waste acceptance criteria. The design requires the storage vessel, piping, and valves to be constructed of stainless steel rather than carbon steel because of the pH of the waste stream. In addition, all of the piping and connections are to be welded construction to prevent the potential for leaks developing at threaded or flanged fittings.*

The need to design secondary confinement into the waste management systems or components needs to be based on the analysis of the hazards associated with the potential failure of the primary systems. However, it is generally expected that systems handling liquid wastes will have secondary confinement to minimize the impacts of leaks, spills, or overflows. The secondary level of confinement may be provided by use of double-walled equipment, e.g., double-walled vessels or pipelines, or by using catchments, e.g., diked or bermed areas, or drip pans.

Designs must also account for the flow of air necessary to maintain waste confinement. Air flow is to be from areas of lesser contamination to areas of greater contamination. To ensure that proper airflow is maintained, the ventilation system design includes equipment which monitors air pressure between different levels of confinement and provides alarms if an adequate pressure differential is not maintained. From the area of highest contamination the air needs to be exhausted through an appropriate filtration system (see guidance below on ventilation).

Example: A treatment facility is designed for processing remote-handled transuranic waste in a process cell. The process cell is in a room which serves as a secondary confinement. The building ventilation system is designed so that the air flows from the nonradiological portions of the building, into the process room, and from the process room into the process cell. The ventilation system is also designed to measure the relative pressure between adjacent confinement layers. If the pressure within the process cell is not negative relative to the pressure in the process room, or if the pressure in the process room is not negative relative to the pressure in the rest of the building an alarm sounds to indicate that confinement has been compromised.

Compliance with this requirement is demonstrated by transuranic waste treatment and storage facilities providing primary and secondary confinement commensurate with hazards identified in a safety analysis or similar documentation.

Supplemental References: None.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(b) Ventilation.

1. Design of transuranic waste treatment and storage facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations in treatment or storage facilities, ventilation or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Objective:

The objective of this requirement is to ensure that airborne effluents released from transuranic waste management facilities are in accordance with applicable DOE Orders and external

regulations, and to preclude or mitigate the accumulation of flammable or explosive gases which could lead to fire or explosion and the uncontrolled release of radioactive material.

Discussion:

This requirement is based on a similar requirement developed to address a group of hazards that was identified during the development of the high-level waste chapter of the *Radioactive Waste Management Manual*, DOE M 435.1-1. During the development of the Manual, it was determined that hazardous conditions can result from the unexpected or uncontrolled release of radioactive material that could result from poorly designed ventilation systems or due to the accumulation and ignition of flammable or explosive gases. Similar situations could occur at a transuranic waste management facility and should be addressed to prevent uncontrolled airborne releases of radioactivity that could endanger workers, the public, or the environment. Subrequirement III.M.(2)(b)1 is discussed below under Airborne Effluent Filtration Systems and subrequirement III.M.(2)(b)2 is discussed under Flammable and Explosive Gases.

Airborne Effluent Filtration Systems. The subrequirement to maintain radioactive material in airborne effluents from transuranic waste management facilities to appropriate levels through the use of filtration systems is to be implemented using the graded approach. This requirement is intended to ensure that transuranic waste management facilities have adequate filtration where necessary, not to dictate that each facility must have a particular type of air filtration or removal efficiency. Therefore, the safety analysis or assessment for each facility will provide the basis for determining the level of filtration required.

> *Example 1: A transuranic waste treatment facility is constructed so transuranic waste packages can be opened, the waste sorted, and the appropriate waste thermally treated. In order to ensure worker protection, the building ventilation system is constructed to draw air from radiologically clean areas, to radiologically-controlled areas and finally to airborne contamination areas such as glove boxes and thermal treatment equipment. Through the auditable safety assessment, it is determined that the potential exists for releases of radioactive materials through the exhaust system. The building exhaust system is therefore equipped with high-efficiency particulate air filters to ensure that releases are controlled to within limits. Monitoring is used to ensure the necessary removal efficiency is maintained by the air filter system.*

> *Example 2: A storage building is designed and operated to receive only closed containers of transuranic waste and to perform nondestructive testing. Through the preparation of an auditable safety assessment it is determined that the potential for release of radioactivity in the building is very low. Consequently, the ventilation system provided for the building is only for climate control and not for contamination control. The building exhaust system is determined to need no extra filtration to comply with the*

requirements to meet applicable release standards, and the rationale and basis of the analysis is incorporated into the facility safety documentation.

Standards for DOE compliance with airborne releases are contained in DOE 5400.5, *Radiation Protection of the Public and the Environment*, and 40 CFR Part 61. The limits for release cited in these documents are for the DOE site (i.e., all the activities of the Department), not for individual facilities. Therefore, the operational limits for any individual facility need to be established based on the potential impacts from all facilities on the site. Consistent with Departmental practices and an underlying principle in development of the *Radioactive Waste Management Manual*, airborne effluent releases need to be kept as low as reasonably achievable.

The number, size, and design of air filtration equipment need to meet the performance requirements dictated by the safety analysis or assessment. The location of air filtration units in the ventilation system is established as close as practical to the source of contamination so as to minimize spread to the remainder of the ventilation system. The system is designed for ease of maintenance and periodic inspection and has provisions (test ports) to facilitate insertion of measuring devices for testing filter performance. Where larger loads are expected or predicted on the filtration systems (e.g., dusty condition), pre-filters need to be considered to extend the life of the main filter and reduce maintenance.

Flammable and Explosive Gases. The subrequirement addressing explosive or flammable concentrations of gases is intended to ensure that the design of facilities and equipment includes consideration of the potential for generating these types of gases. Generation of flammable or explosive gases has been a concern in the storage of liquid waste (e.g., high-level waste tanks), but also needs to be recognized as a potential problem in other situations, such as in treatment systems.

Where sampling data and safety analyses indicate a potential for accumulating gases in concentrations approaching the lower flammability limit, facilities and equipment shall be provided to prevent the conditions which could lead to fire or explosion. This is normally accomplished by the design and installation of ventilation equipment which provides enough air flow to maintain gases below flammable or explosive concentrations. In situations where gas evolution is episodic and the concentration of gases approaches the lower flammability limit for short periods of time in spite of the ventilation system, spark-proof technology needs to be employed in the design of ventilation equipment so that the equipment itself does not become a source of ignition.

Attention to fire protection for the filtration system also needs to be considered to ensure the facility can perform under off-normal conditions. Guidance for protection of filtration systems in ventilation plenums for nuclear facilities is provided in the *Fire Protection Design Criteria* (DOE-STD-1066-97). This guidance addresses materials of construction, location of filters, fire ratings of protective walls, and internal detectors for fire and heat.

Other methods can be employed to prevent conditions which could lead to ignition of flammable or explosive gases. One such method is the introduction of a sufficient flow of inert gases into the headspace where flammable or explosive gases would accumulate. The inert gases need to be supplied at a rate that keeps the concentration of the flammable or explosive gases and of available oxygen/oxidants below levels that could result in deflagration or detonation. As with ventilation equipment, the specific conditions of gas generation and of providing an inert atmosphere in the headspace must be evaluated and a decision made as to whether spark-proof technology should be included in the design of the system.

Compliance with this requirement is demonstrated by analyses that support the level of filtration provided on a transuranic waste management facility, and if airborne effluent monitoring data are available, a demonstration of compliance with the site-established operational guidelines for the facility. In addition, acceptable implementation is demonstrated by analyses, monitoring data, or both showing that the potential for generation of explosive or flammable concentrations of gases has been considered and where the potential exists, the presence of ventilation equipment or other means that prevent deflagration or detonation. The analysis and rationale for the selected controls must be documented in the radioactive waste management basis.

Supplemental References:

1. DOE, 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

2. DOE, 1997. *Fire Protection Design Criteria*, DOE-STD-1066-97, U.S. Department of Energy, Washington, D.C., 1997.

3. EPA. *National Emission Standards for Hazardous Air Pollutants*, 40 CFR Part 61, U.S. Environmental Protection Agency, Washington, D.C.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(c) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing transuranic waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Objective:

The objective of this requirement is to ensure the incorporation of the concept of life-cycle waste management into the design and construction of radioactive waste management facilities to minimize the amount of radioactive waste that must be managed in the future from decontamination and decommissioning activities, and to reduce the number of facilities that must be dismantled due to contamination rather than re-used for another beneficial purpose.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the concept of life-cycle management of waste was identified as a key theme that would promote safety and provide a long-term benefit in reducing hazards associated with radioactive waste management. This requirement was developed to extend the life-cycle management concept to the design of facilities used for the management of radioactive waste. The goals of applying this concept at the design stage are to minimize the future generation of waste and to promote the planning for subsequent beneficial use or decommissioning of a facility at the end of its original mission. Decontamination and decommissioning activities also becoming a significant part of the life-cycle costs for transuranic waste facilities. This requirement addresses this situation by promoting proactive consideration of design features that facilitate decontamination and dismantlement activities that will lead to a beneficial use or decommissioning.

New transuranic waste facilities are defined as those whose design basis was not approved prior to the implementation date of DOE O 435.1. The term design basis is defined in the Manual Definitions. If a transuranic waste facility's design basis is defined after the issuance date of DOE O 435.1, the requirements of this section are applicable. Similarly, if a significant modification to an existing facility is made after the implementation date of DOE O 435.1, this requirement to incorporate features that facilitate decontamination and to consider eventual facility decommissioning or reuse applies. Application of these requirements to existing facilities should be considered and applied on a case-by-case basis. To support this decision, an analysis needs to be conducted comparing the expected benefits by the application of these requirements to the costs of implementing such measures. These costs include programmatic impacts, resource and schedule impacts, as well as potential impacts such as additional worker exposures due to radiation and chemical hazards, and future costs.

Design to Facilitate Decontamination. Decontamination is defined by the Implementation Guide to DOE O 420.1, *Facility Design*, as "the act of removing a chemical, biological, or radiological contaminant from or neutralizing its potential effect on a person, object, or environment by washing, chemical action, mechanical cleaning, or other techniques." In conjunction with DOE O 420.1, DOE M 435.1-1 requires that transuranic waste facilities incorporate measures to reduce areas of contamination or to simplify decontamination of areas that may become contaminated

with radioactive or hazardous materials to facilitate either decommissioning or reuse of the facility. Following are design features that need to be considered:

- Service piping, conduits, and ductwork kept to a minimum in areas that could be potentially contaminated and, if included in such areas, their design arranged to facilitate decontamination.

- Cracks, crevices, and joints filled and finished smooth to prevent accumulation of contaminated material.

- Walls, ceiling, and floors in areas vulnerable to contamination finished with washable or strippable coverings.

- Metal liners, e.g., stainless steel cell lining, used in areas that have the potential to become highly contaminated with radioactive materials.

- Contaminated or potentially contaminated piping systems have provisions for flushing and/or cleaning.

- Accessible, removable covers for inspection and cleanouts provided.

- Construction materials that reduce the amount of radioactive materials requiring disposal and that are easily decontaminated.

Example: A transuranic waste thermal treatment facility is being planned. The facility design is reviewed to determine the ease with which the constructed treatment facility could be decontaminated following its operational life. The evaluation finds that transuranic waste transfer lines can be modified by including liners, and certain areas are found to be amenable to the use of strippable coverings. The design is modified to incorporate these changes and improve the ability to decontaminate the facility.

<u>Design to Support Decommissioning</u>. Decommissioning, also defined in DOE O 420.1, is "the process of closing and securing a nuclear facility or nuclear materials storage facility to provide adequate protection from radiation exposure and to isolate radioactive contamination from the human environment." Design features that need to be considered to support decommissioning or a reuse of the facility include:

- Use of modular radiation shielding, in lieu of or in addition to, monolithic shielding walls.

- Use of modular, separable confinements to preclude contamination of fixed portions of the structure.

- Designs that ease cut-up, dismantlement, removal, and packaging of contaminated equipment, such as glove boxes, air filtration equipment, large tanks, vessels, and ductwork, from the facility.

- Use of localized liquid transfer systems that avoid long runs of buried, contaminated piping; emphasis on localized batch solidification of liquid waste. Special provisions may also be included in the design to ensure the integrity of joints in buried pipelines.

- Piping systems that carry contaminated or potentially contaminated liquid that free drain by gravity.

- Location of exhaust filtration components of ventilation systems at or near individual enclosures to minimize long runs of internally contaminated ductwork.

- Equipment, including effluent decontamination equipment, that precludes to the extent practicable, the accumulation of radioactive or other hazardous materials in relatively inaccessible areas, including turns in piping and ductwork.

- Provisions for suitable clearances, where practical, to accommodate remote handling and safety surveillance equipment required for future decontamination and decommissioning.

- Use of lifting lugs on large tanks and equipment.

Decommissioning and Reuse Planning. Due to the high life-cycle costs of transuranic waste facilities, this subrequirement is also intended to promote post-mission planning of transuranic waste facilities by requiring the identification of possible decommissioning methods or reuses of transuranic waste facilities as early as possible. To meet this requirement transuranic waste facility designs, or significant modification efforts, need to include analysis to determine the best decommissioning methods, using currently available technologies, and factor the results of this analysis into the facility's design. Likewise, if a reuse of the facility is envisioned, any features that can support this reuse mission need to be considered in the design effort.

Life-Cycle Asset Management, DOE O 430.1A, addresses deactivation and decommissioning requirements of DOE facilities. Refer to DOE O 430.1A and its Guides for further information on additional information on deactivation and decommissioning activities. Refer also to a new

DOE Standard, listed below, on the integration of safety and health requirements into facility disposition activities.

Compliance with this requirement is demonstrated by the existence of design documentation that indicates decontamination was considered during the design of new transuranic waste facilities or significant modifications to transuranic waste facilities. Additionally, Site-Wide Radioactive Waste Management Program documentation demonstrates that post-mission planning was considered, as early as possible in the life of a facility, to assist in the identification of possible decommissioning methods or facility reuse.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft G 420.1-X, U.S. Department of Energy, Washington, D.C., September 1995.

2. DOE, 1997. *Decommissioning Implementation Guide*, Draft G 430.1-4, U.S. Department of Energy, Washington, D.C., October 1, 1997.

3. DOE, 1997. *Integration of Safety and Health into Facility Disposition Activities,* Draft for DOE Complex Wide Review 9/26/97, DOE-STD-1120-98, U.S. Department of Energy, Washington, D.C., September 26, 1997.

4. DOE, 1998. *Life-Cycle Asset Management*, DOE O 430.1A, U.S. Department of Energy, Washington, D.C., October 14, 1998.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(d) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of transuranic waste treatment and storage facilities to provide volume inventory data and to prevent spills, leaks, and overflows from tanks or confinement systems.

Objective:

The objective of this requirement is to ensure that engineered controls are included in the design of transuranic waste storage and treatment facilities to minimize the likelihood of release of radionuclides that could lead to exposures or contamination of the environment.

Discussion:

This requirement for instrumentation and engineering controls is invoked to address a group of hazards that was identified during the development of DOE O 435.1 and DOE M 435.1-1 -- the failure to promptly detect and prevent conditions which could lead to a release of radioactive material from transuranic waste storage or treatment facilities that could impact workers, the public, or the environment. This requirement is closely related to the previous design requirement for monitoring systems. However, this requirement focuses on controls to prevent the loss of containment.

The engineered controls referred to in this requirement are those systems or design features that are provided to detect and prevent the loss of containment of transuranic wastes volumes in treatment or storage facilities, and to provide volume inventory data, where appropriate. During the design of storage or treatment systems, the flow of waste material through the system should be evaluated to determine where there is a potential for the loss of containment by overfilling or spilling. Examples of engineering controls include flowmeters and level-sensing devices coupled with anti-siphon devices or shut-off valves, and any other instrumentation and controls that maintain sufficient freeboard within a storage vessel or unit. Other instruments and controls include devices that measure changes in characteristics of liquid waste, e.g., temperature, pressure, pH, and/or other characteristics providing a measure of a materials stability, that are combined with shutoff or diversion routing devices. Although this requirement most obviously applies to management of liquid wastes, it also needs to be considered and applied, as appropriate, to solid transuranic waste.

Example 1: A tank system has been installed to receive and store transuranic wastes pending treatment. The wastes are transferred by pipeline to the tanks. The design of each tank includes a liquid level sensor which is coupled to an alarm and diversion valve. When the liquid level is at 88% of the tank depth an alarm sounds on the control room annunciator panel. When the liquid level reaches 92% of the tank depth the diversion valve is automatically actuated and the liquid level is transferred to a spare tank.

Example 2: A facility is being designed to provide thermal treatment of transuranic waste. The thermal treatment unit is designed for continuous feed and continuous discharge of the ash and slag to a disposal container. To avoid the loss of containment, an interlock is included in the design which prevents feed from entering the combustion chamber and waste product from leaving the chamber if a disposal container is not in place at the discharge of the thermal treatment unit.

The graded approach is used in determining the appropriate level of engineering controls to incorporate into the design of transuranic waste management facilities. As indicated in the

preceding examples, sensing devices, alarms, and spill or overflow prevention features are most appropriate in facilities storing liquids or with continuous, automatic processes. Other instances involving bulk or solid transuranic waste may need to invoke these controls as well, where a simple shutoff of the equipment could prevent overfilling or other hazardous conditions.

The design of engineering controls to meet this requirement will most likely be directed by the facility-specific safety analysis or safety assessment prepared for the waste management facility. Such safety analyses or assessments may dictate that certain engineering controls be designed as safety-class or safety-significant systems, structures, or components (SSC) to ensure they survive design-basis accidents. Use of the safety analysis process, as prescribed by DOE 5480.23, *Nuclear Safety Analysis Reports*, to identify the necessary engineering controls to meet this requirement for both new and upgrades to existing transuranic waste treatment and storage facilities, is considered appropriate and encouraged.

Loss of containment at a waste storage or treatment facility can result from overflows, spills, leaks, or siphoning of waste from a storage vessel. Incorporation of design measures at these facilities to prevent such loss of containment is necessary, but is not necessarily sufficient to adequately control the hazards associated with release of radioactive materials. Equipment of this nature, in spite of rigorous maintenance, can fail over its expected service life. Therefore, as discussed in the above guidance on confinement, an engineered barrier to fully contain the spilled waste or a diversion mechanism to channel the waste to a desired location provides defense-in-depth for the circumstances where the engineering controls do not function.

> *Example: At the Liquid Transuranic Waste Storage Facility, the engineering controls on the liquid transuranic waste storage tanks include a waste feed line shut-off valve, activated by a tank liquid level-sensing device, to prevent overflow of waste from the tank. In addition, the tank is designed with an overflow line so that if the valve malfunctions and the tank is overfilled, the overflow is routed to another waste tank that is maintained as a spare at the storage facility.*

Compliance with this requirement is demonstrated by the incorporation of engineering controls in storage facilities or treatment processes that provide detection and automatic shutoff or diversion of the flow of waste materials that could otherwise spill or overflow the system as documented in the facility's safety documentation.

Supplemental References:

1. DOE, 1995. *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria*, Revision G, Draft DOE G 420.1-X, U.S. Department of Energy, Washington, D.C., September 1995.

2. DOE, 1992. *Nuclear Safety Analysis Reports,* DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

III. M.(2) Facility Design. The following facility requirements and general design criteria, as a minimum, apply:

(e) Monitoring. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of transuranic waste storage, treatment, and disposal facilities to provide rapid identification of failed confinement and/or other abnormal conditions.

Objective:

The objective of this requirement is to ensure the design and installation of equipment capable of identifying failures in containing transuranic waste and other conditions that could result in exposure of the public, workers or releases to the environment.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the hazards analysis identified releases resulting from confinement failure of a component or from failure to stop transfer of waste when the receiving vessel (e.g., tank or bin) is full as a hazard that needs to be mitigated. The requirement discussed here is generally directed toward prompt detection of acute releases (releases that are detectable visually or by some other gross indicator) that become apparent over a time frame of hours or days. In contrast, the requirements for monitoring (see DOE M 435.1-1, Section III.Q) for compliance with release limits is directed toward detection of releases that generally evolve slowly and may be detected by low threshold environmental monitoring devices weeks, months, or longer after the release begins.

As in implementation of all of the requirements of DOE O 435.1 and DOE M 435.1-1, the graded approach is used for determining the appropriate level of rigor in applying this control to the management systems employed at a particular waste management facility. Also, monitoring for leakage and contamination spread needs to be performed by means appropriate for the type and character of radioactive waste being managed at the facility. Rigorous application of this requirement may be most appropriate for circumstances involving storage or treatment of liquid transuranic waste, for example, highly acidic liquid waste in a single-walled, mild steel tank may require continuous monitoring coupled with alarms and transfer equipment. A treatment facility involving solid waste may need to implement monitoring systems such as portable constant air monitoring systems designed to detect airborne contamination spread from dry processes. A

facility storing containerized waste may rely on a program of container inspections to meet the needs for monitoring for leaks and abnormal conditions.

For transfer systems, designers may need to consider the use of continuous flow monitors to allow comparisons of total volume input to total volume output as an indicator of the integrity of the transfer system. The containment integrity of waste transfer systems can also be monitored for radiation levels in excess of those expected from residual waste in the transfer system.

A highly reliable means of monitoring for releases is the use of secondary confinement which is then checked for waste. It also offers the benefit of providing defense-in-depth in containment of releases of transuranic waste.

> *Example: A liquid transuranic waste transfer line from a storage tank to a treatment facility is enclosed in a larger diameter secondary containment tube. The transfer line and containment tube were constructed with sufficient pitch to cause any leakage into the containment tube to flow back to the storage tank area. The transfer line developed a leak at a coupling which was discovered when waste was found in the secondary containment at the storage tank area.*

What constitutes rapid detection of failed confinement or abnormal conditions needs to be established for each facility, operation, or activity. Monitoring design requirements and engineering controls to address catastrophic failures will be established through the conduct of safety analyses. The failures and conditions being addressed by this requirement are those that are not catastrophic, but could result in releases of radioactivity or doses to workers or the public in excess of established limits if they were allowed to continue over a period of hours or days. Detection equipment needs to be designed to detect confinement failures or abnormal conditions rapidly enough that action can be taken before the situation degrades to the point that response and recovery would result in doses to workers that approach the dose limits for radiation protection of workers (10 CFR Part 835). Similarly if the failure releases radioactivity to a air or liquid effluent stream, detection needs to occur rapidly enough to prevent environmental releases from exceeding annual limits.

Compliance with this requirement is demonstrated by a documented basis for the design of monitoring for transuranic waste systems and the capability to monitor waste volume and detect volume changes in a time frame that will allow implementation of corrective measures to limit public and worker doses to allowable levels and to limit releases to the environment.

Supplemental References:

1. DOE. *Occupational Radiation Protection,* 10 CFR Part 835, U.S. Department of Energy, Washington, D.C.

III. N. Storage.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Storage Prohibitions. Transuranic waste in storage shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water. Prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable.

Objective:

The objective of this requirement is to promote safe storage of transuranic waste by eliminating from storage materials which could result in fires or explosions due to their reactivity or ignitability.

Discussion:

The safe storage of transuranic waste can be jeopardized by the presence of materials which may ignite or explode. To avoid the potential for accidental releases from stored wastes, this requirement prohibits storage of materials that are known to be readily capable of ignition or explosion, or which may degrade over time to be ignitable or explosive. In establishing waste acceptance criteria for storage, waste managers must prohibit the acceptance of materials which have the potential of igniting or exploding. The following materials are not to be stored:

- Reactive metals - metals that can react violently with water, form potentially explosive mixtures with water, or ignite when exposed to air; e.g., uranium or plutonium metal turnings are reactive metals.

- Certain dried ion exchange resins - organic ion exchange resins which have been used for treating solutions containing nitrates have the potential of igniting or exploding if they are allowed to dry out.

- Cellulosic materials contaminated with strong oxidizers - cellulosic materials can spontaneously ignite due to the presence of strong oxidizers, e.g., concentrated nitric acid.

- Volatile materials if stored in areas of high temperatures - storage of volatile materials in closed containers subject to high temperature can result in pressurization of the container and, depending on the waste materials, evolution of flammable gases.

- Pyrophoric materials - nonradioactive materials which can ignite spontaneously are not to be packaged for storage. Radionuclides which may be pyrophoric are to constitute less than 1% by weight of the container contents unless they are treated to eliminate the pyrophoric characteristic.

When waste with the characteristics described above have been generated, it is necessary to treat them prior to placing them into storage. The treatment may consist of causing the reaction to occur under controlled conditions, e.g., oxidation of pyrophoric metals such as uranium fines, or may involve the stabilization of waste materials so that they are no longer flammable or explosive.

Example 1: In the process of cleaning out a glovebox, paper absorbent was used to clean up an acid spill. Prior to placing the absorbent material into a drum for prolonged storage, it is taken to a RCRA-permitted treatment facility where the acid is neutralized and the absorbent dried. The treated absorbent materials are then packaged to meet the waste acceptance requirements of the transuranic waste storage facility.

Example 2: Metal fines from machining operations are routinely generated as a transuranic waste stream. In order to meet the storage requirements and make the waste acceptable for future disposal, the fines are treated by solidification in a cement matrix in 1-gallon cans. Upon curing, the 1-gallon cans are placed in 55-gallon drums along with filler material that prevents shifting within the drum. The drums are then sent to the on-site storage facility.

Compliance with this requirement is demonstrated by having waste acceptance requirements which prohibit waste that is ignitable or explosive from being accepted for storage unless it has been treated.

Supplemental References: None.

III. N.(2) Storage Integrity. Transuranic waste shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure.

Objective:

The objective of this requirement is to ensure that the selection of the location and method for storing transuranic waste is made so that both workers and the containers of waste are provided with adequate protection.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the storage of radioactive waste was identified as an activity that presented potential risk to the public, workers, and the environment. Numerous weaknesses and conditions which could lead to release of waste or exposure of workers were identified during the safety and hazards analysis and subsequent reviews conducted in support of the Manual documentation. In addition, previous reviews of radioactive waste storage conditions and management practices (e.g., *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities)* revealed inadequately or improperly stored waste, which presents the possibility of human exposure to radiation and the potential for adverse environmental effects.

The evaluations of storage that were conducted during development of the Order and Manual revealed a variety of current practices and required lengths of storage for transuranic waste. Transuranic waste is stored in dense-pack arrays, in earthen-covered configurations, and in modern, RCRA-compliant storage facilities. In addition, in order to protect the transuranic waste containers, buildings not originally designed or intended for storage are sometimes used when other storage capacity is not available.

As discussed in the General Requirements guidance on storage (DOE M 435.1-1, Section I.2.F.(13)), a principal element of proper storage is ensuring that the container is protected from degradation so that it can perform its intended function until it is disposed. This requires that containers be protected from mechanical damage and from environmental conditions that could impact the waste and container.

> *Example 1: Due to a large decommissioning project generating unanticipated volumes of transuranic waste, Site Z decided to store transuranic waste outside until indoor storage space could be made available. In accordance with the Packaging and Transportation requirements, filtered vents were installed on the drums used for packaging the waste. However, in establishing the radioactive waste management basis for the outside storage pad, personnel failed to recognize the potential for precipitation entering the drums. Rain accumulated on the tops of the drums, then due to fluctuations in barometric pressure, the drums "breathed" through the vents. Water was sucked in through the vents resulting in the need to repackage the waste so that the containers would not corrode and so they could meet the waste acceptance requirements for disposal. Subsequently, any waste drums that had to be left outside were provided with covers that prevented water from accumulating on the tops.*

> *Example 2: Due to a large backlog of transuranic waste, Site Y is required to store transuranic waste outside until it can be shipped to the Waste Isolation Pilot Plant for disposal. The waste is stored in containers which prevent the entrance of precipitation*

(lid with lips extending down over the sides) and which resist corrosion (painted carbon steel). Controls are in place to limit mechanical damage from vehicles and other operations in the area. The containers are inspected on a monthly basis for deterioration and repaired as necessary to maintain containment of the waste (e.g., painted, contained). Personnel are only in the outside storage area during periods of inspections, container maintenance, and container movement. The outside storage has been analyzed and documented to provide adequate protection for the expected storage time. This storage maintains the integrity of the waste and minimizes worker exposure.

Transuranic waste may be stored in facilities designed specifically for waste storage, as well as in facilities or portions of facilities which originally served another function but have now been converted for use a storage facility. Any facility to be used for transuranic waste storage must comply with the applicable requirements of DOE O 420.1, *Facility Safety*. Special attention is to be given to DOE O 420.1, Section 4.2, Fire Protection, when a facility is to be used for the storage of combustible materials. If facilities have the appropriate provisions (e.g., ventilation, fire suppression) for the type of waste being stored, their use is preferable to storing the waste containers outside and subjecting them to the elements.

In making a decision to use a facility for storage and in developing a radioactive waste management basis for the activity, particular attention to protection of workers is needed. Waste is not to be stored in areas where workers are required to spend extended periods of time in performing other duties (i.e., any duties not related to managing and monitoring the waste). This limits the facilities or areas of facilities that should be used for waste storage to those that are excess to current site missions or those that are infrequently accessed as part of normal operations.

Compliance with this requirement is demonstrated if sites have storage capabilities for transuranic waste that provide protection of waste containers so that their integrity will not be damaged through physical or chemical (corrosion) processes and that keep personnel from spending extended periods of time in the areas where transuranic waste is stored.

Supplemental References: None.

III. N.(3) Container Inspection. A process shall be developed and implemented for inspecting and maintaining containers of transuranic waste to ensure container integrity is not compromised.

Objective:

The objective of this requirement is to prevent or minimize the potential exposure of workers and release of radioactive contamination to the environment that could result from allowing transuranic waste containers to degrade. The requirement is intended to ensure that the confinement abilities of containers is routinely evaluated and action taken to ensure the waste remains contained.

Discussion:

The containment of transuranic waste in its container is essential for its safe and effective management. During the development of the *Radioactive Waste Management Manual* (DOE M 435.1), inadequate or substandard waste containers and deterioration of containers were identified as a conditions that could result in the loss of waste containment and potentially impact workers, the public, or the environment. The General Requirements of the *Radioactive Waste Management Manual* (DOE M 435.1-1, Section I.2.F.(13)) assign the Field Element Manager responsibility to ensure that all waste is stored in a manner that protects the integrity of the waste container for the expected time of storage. The responsibility for providing adequate storage that protects the integrity of waste containers is complemented by this requirement to routinely inspect the packages and correct any conditions of container deterioration. This is particularly important for transuranic waste that is to be in relatively long-term storage (e.g., waste that will not be shipped to WIPP for a number of years or non-defense waste for which a disposal facility has not been identified). This requirement applies to all storage of transuranic waste, not just storage at a designated storage facility.

> *Example: An assay facility has two areas where waste is staged, one for containers of waste awaiting assay and another for those to be placed into storage after they have been assayed. The assay facility personnel have established operational procedures for the routine physical examination of all waste containers in either staging area. Existence of the inspection process mitigates concerns about waste residing in the staging areas for longer than normal as a result of assay equipment failure or maintenance. The facility procedures also address actions to be taken if waste container integrity is suspect.*

<u>Inspection</u>. The waste container inspection and corrective action process is to ensure that container integrity is maintained throughout the storage or staging period. The process needs to be tailored to the storage situation. Ideally, the storage configuration would allow visual or remote visual inspections of the outsides of waste containers. The inspection considers:

- General condition of the container, such as areas of rust, scratches, and minor dents. The inspection process includes an evaluation of minor surface conditions to determine their impact on the integrity of the container. Such conditions may

not require any action, but are to be noted and corrected if there is a trend indicating eventual deterioration.

- Functioning of the waste container closures. Waste container closures are in place and securely fastened.

- Evidence of leakage. Leakage can indicate a number of problems including unacceptable materials in the waste, inadequate internal containers, insufficient absorbent, or failure of the outer container.

- Evidence of structural problems with the container such as buckling or split seams.

- Bulging of the waste container indicating build up of pressure in the container. Bulging of the container may indicate inappropriate storage conditions (e.g., storing tightly sealed waste containers where they are subject to excessive heating), a condition inside the container that needs to be remediated, and the need to replace the container.

- Examination of waste container marking and labeling to ensure that they are maintained in a legible condition.

Example: Transuranic waste is stored in rows two drums wide and two drums high with an aisle between the rows. The site procedure calls for an operator to inspect the condition of the drums every two weeks and record any potentially adverse conditions.

Some older storage configurations (e.g., dense pack storage where there are multiple rows and layers of waste packages without access space between them) may not allow for direct visual inspection. In such cases, the inspection may have to be done using remote or indirect techniques. Remote techniques include the use of video cameras which provide real time or recorded displays of waste containers which are not accessible for direct inspection. Indirect methods include the use of radiation detectors to determine when a waste container has failed. To the extent possible, direct remote visual inspections are to be used in preference to indirect methods since indirect methods force the inspection and maintenance process into a reactive mode of fixing problems once they have occurred (as detected by an increase in radioactive contamination) rather than a proactive mode of preventing breaching of the waste container.

Example: Drums stored in a dense pack array are in a building that has a continuous air monitor. To ensure adverse waste package conditions are detected as soon as practical, additional monitoring is performed on a routine basis. The additional monitoring involves the collection of smear samples by placing swabs on extensions to check for loose contamination within the array.

Waste containers should be physically examined about every 30 days to ensure that storage conditions have not caused the integrity of the container to be compromised. All waste packaging that exhibits serious deterioration or exhibits a potential for containment of the waste to be jeopardized need to be replaced or overpacked.

Example: During the routine inspection of waste drums at a staging area a drum was identified as possibly damaged. Upon detailed inspection, it was determined that a seam of the waste drum had separated. The waste was repackaged and the old drum removed from service.

Maintenance. The process for waste container maintenance is to include preventive actions as well as corrective actions. Preventive actions would address minor conditions associated with ensuring waste containment. Actions might include cleaning and painting small areas on metal to curb corrosion that could eventually compromise the container. The process also is to provide capabilities to respond to more serious conditions up to and including breaching of the container (e.g, from accidental puncture or corrosion).

Maintenance of containers in response to acute conditions (i.e., conditions where there is a release or imminent threat of a release) provides for prompt containment of the release, assessment of the situation, and remedying the situation. The immediate response is to ensure that release of contamination is controlled. Control actions may be as simple as replacing a bolt or closure ring on a drum, or covering a hole in a container with tape. More serious conditions may require placing the waste container in a catch tray or immediately placing it in an overpack. The condition causing the breach or potential breach must be assessed so that, if necessary, the causative factors can be corrected. If corrosion is affecting the waste container, the reason for the corrosion needs to be determined so an effective response can be made. If there is a corrosive material in the waste container, overpacking may only temporarily correct the problem. In such a situation, it may be more appropriate to treat the waste or to provide a liner that is resistant to corrosion. If there is buckling of the waste container or split seams, an assessment needs to be made of whether the contents are too heavy, whether the container is improperly designed, or whether it was mishandled (e.g., dropped). In cases where an external event is the cause of the damage (e.g., a waste container is dropped or struck by equipment), repackaging or overpacking in a similar container is appropriate.

Example: The inspection process in a storage facility identified a waste drum that was corroding even though the container was stored in acceptable conditions and the paint on the drum was in good shape. Storage facility personnel recognized that there was a need to investigate whether the contents of the container were causing the corrosion. Evaluation of the container contents confirmed that the waste was contaminated with corrosive material. The waste was treated to neutralize its corrosivity, then repackaged in a similar container.

Waste managers are not to interpret the term "maintenance" to imply that refurbishment of deteriorating waste containers is required. The basic premise of this requirement is that potential doses to workers are to be avoided. Therefore, overpacking may be the most appropriate action as opposed to an action requiring handling of the waste and a failed container.

Compliance with this requirement is demonstrated by a documented process for waste container inspection and maintenance at every facility managing transuranic waste, and documentation for all waste container inspections and maintenance actions performed.

Supplemental References: None.

III. N.(4) Retrievable Earthen-Covered Storage. Plans for the removal of transuranic waste from retrievable earthen-covered storage facilities shall be established and maintained. Prior to commencing waste retrieval activities, each waste storage site shall be evaluated to determine relevant information on types, quantities, and location of radioactive and hazardous chemicals as necessary to protect workers during the retrieval process.

Objective:

The objective of this requirement is to promote the removal of retrievably-stored transuranic waste from earthen-covered storage and its transfer to subsequent waste management facilities where there is less potential of release to the environment. Additionally, the purpose of the requirement is to ensure that, to the extent practical, information about the waste is collected and analyzed so hazards associated with the waste can be mitigated through selection of equipment, development of procedures, and implementation of work practices.

Discussion:

The General Requirements chapter of DOE M 435.1-1 assigns the Field Element Manager responsibility for ensuring that waste is stored in a manner that is protective of the public, workers, and the environment. Additionally, the Field Element Manager is responsible for ensuring the integrity of waste containers during the time they are stored (DOE M 435.1-1, Section I.2.F.(13)). This requirement supplements the General Requirement by encouraging the removal of waste from storage configurations that may contribute to the degradation of waste containers.

Following implementation of the 1970 Immediate Action Directive (AEC, 1970) concerning solid waste management, the Department began storing waste suspected of being transuranic waste

with the intent of retrieving it for future disposal. Waste disposed of prior to the implementation of the 1970 Immediate Action Directive is not retrievably stored transuranic waste and therefore, is not subject to this requirement. Generally, such wastes are managed pursuant to the *Comprehensive Environmental Response, Compensation, and Liability Act.*

To implement the Immediate Action Directive, a number of DOE sites designed storage configurations that involved placement of containers of transuranic waste (or waste suspected of being transuranic waste) in lined or unlined trenches, or at grade, then covering them with soil. At the time of emplacement, the configuration was intended for 20-year retrievable storage. Much of this waste is still in earthen-covered storage, some of it beyond the originally planned 20 years. Experience gained through investigations and retrieval activities has shown that in some cases the integrity of the containers has been compromised (e.g., moisture condensing on metal containers has led to significant rusting).

During the development of DOE M 435.1-1, *Radioactive Waste Management Manual*, a safety and hazards analysis identified the potential release of radioactivity to the environment from waste packages in earthen-covered storage and the concomitant hazard to retrieval workers, as conditions for which radiological controls were needed. Likewise, it was also recognized that the longer waste containers remain in earthen-covered storage configurations, the greater the likelihood of a release. Therefore, this requirement was developed to promote the movement of waste to more acceptable conditions (i.e., better storage conditions, treatment, or disposal). The hazards to workers are to be mitigated by acquiring as much information as practical about what will be encountered upon exhumation and implementing controls to address those hazards.

Retrieval Plans. Plans for retrieval of waste from earthen-covered storage will vary depending on the stage of development of the retrieval program, and will need to be updated (maintained) as the program progresses. In the early stages, the planning will be primarily programmatic with the focus on identifying and developing the information and infrastructure needed to effect retrieval. This planning integrates with the documented Site-Wide Program (see DOE M 435.1-1, Section I.2.F.(1)) because it reflects the same commitments and milestones addressed in the Site-Wide Program. The plans for retrieval may suffice as the documentation for that portion of the Site-Wide Program. Recognizing that some of the waste placed in earthen-covered storage may not meet the current definition of transuranic waste, the planning needs to address determining whether retrieved containers have transuranic or low-level waste, and the disposition of the different types of waste. The early planning includes the following:

- The scope of the retrieval activity (i.e., the facilities (trenches, above-grade pads, etc.) from which waste will be retrieved);

- A conceptual description of the approach to be used (e.g., method of removing overburden, means of removing tarps and/or plywood covering the waste packages, contamination control during removal operations);

- Data collection (see Pre-Retrieval Evaluation below), analyses, and studies to be conducted in support of retrieval operations;

- Identification of primary facilities and equipment needed to retrieve waste (weather enclosures, drum handling equipment, drum venting equipment, earth moving equipment, transportation vehicles);

- Identification of existing and new support facilities (e.g., needed treatment, storage, and/or disposal facilities);

- Evaluation of retrieved waste containers (inspection, overpacking, assay);

- Management steps for retrieved packages (e.g., venting, storage, treatment, disposal);

- Plans for decommissioning the earthen-covered storage facility following removal of the waste; and

- The cost and schedule for preparing for and accomplishing retrieval of the waste.

Example: A site has waste that was placed into earthen-covered storage under the assumption that it was transuranic waste. As part of the site-wide waste management program, a document is prepared that describes the facilities and equipment envisioned to be needed and the process for retrieving the waste. The document also includes a schedule for collecting and evaluating data associated with the waste, providing the needed facilities and equipment, developing control documentation (e.g., permits, procedures, safety analysis report, health and safety plan), conducting startup activities (operational readiness reviews), and performing the retrieval. The documentation also includes a budget estimate for preparing and conducting the retrieval.

As information is acquired and the infrastructure to support retrieval evolves, the plans for retrieval will need to be updated and become more focused. The planning will become more project specific and include the development of the time-phased plans for retrieving waste, characterization plans, radiological control plans, health and safety plans, and emergency response plans. The planning done at this stage will also be more specific as to the process for exposing and handling drums, including cover removal; waste management (e.g, contaminated soil, plastic, plywood); inspections to be performed; handling non-routine drums (e.g., those that are bulging

or deteriorated); venting of drums; assaying; specific plans for disposition of different waste types (including segregation of defense and non-defense transuranic waste as discussed below); marking and labeling; and movement of drums. The planning provides the basis for developing the procedures that will control waste retrieval.

Pre-Retrieval Evaluation. In the early stages of planning, a key activity is the collection and evaluation of data about the waste that is to be retrieved. Some of these data (e.g., location, volumes) may be readily available in existing data bases and will be used in the early planning. However, prior to developing project-specific plans and procedures controlling retrieval activities, a thorough evaluation of available data needs to be made so that appropriate worker protection can be planned.

The evaluation of information relevant to waste characteristics will involve collecting information on the character of the waste, waste containers, and the storage configuration. The evaluation includes an examination of existing burial records, production records, and design drawings of waste containers and the storage facility and can be supplemented by interviews with current and former employees. To the extent the information is available, the evaluation is to identify the following:

- Type of earthen-covered storage facility (e.g., trenches, above-grade pads, drum stacks);
- Waste storage facility design and construction (e.g., above-grade, below-grade, use of tarps and/or plywood);
- Types of containers present (e.g., 55-gallon drums, fiberglass-reinforced plywood, wooden, or metal boxes) and their approximate sizes and weights;
- Radionuclide species and inventory in the containers;
- Chemical constituents in the waste;
- The presence of waste containers with high dose rates (i.e., above contact-handled limits per site radiological control practices);
- Any other waste or facility characteristics that may affect health, safety, or the environment.

Example: To prepare for retrieval of waste from earthen-covered storage, site personnel undertake a review of available information. They compile copies of as-built blue-prints for the storage facility, review the shipping and transfer records that accompanied the

waste when it was received, and based on the records, identify the containers in which the waste is contained. The shipping and transfer records identify the facilities from which the waste was received, which leads to interview of staff who worked at the facilities that generated the waste. Interviews indicate that there may be other radionuclides present than the few reported on the shipping and transfer records. Expected dose rates from the waste containers available from the shipping and transfer records are corroborated by the staff from the generating facilities.

Evaluation of data about the facility and waste is to be used in developing the detailed retrieval plans and procedures, particularly as they relate to ensuring worker safety. The data can be used to support decisions on container handling procedures (e.g., remote versus contact handling) and the type of personnel protective equipment that may be appropriate. Even if data indicate that a low level of personnel protective equipment is sufficient, initial contact with retrieved waste needs to be undertaken using a high level of protection (e.g., EPA level A or B). Only after the expected level of hazard has been confirmed to be low should the level of personnel protection be lowered.

Example: The evaluation of information about an earthen-covered storage facility leads to the expectation that the waste containers will be in good shape. This means that only Level C protective equipment (anticontamination clothing, no respiratory equipment) is required and that the waste can be contact handled. During initial entry into each storage module, frequent dose rate surveys are conducted and personnel wear respirators until it is confirmed that dose rates are low and there is no airborne hazard.

Compliance with this requirement is demonstrated if personnel have developed plans and continue to show progress towards removing waste from earthen-covered storage facilities and the level of planning is commensurate with the stage of the retrieval program. Early planning describes the approach to be followed and actions to be taken to initiate waste retrieval. Later planning includes the specific activity-based plans that are necessary to support actual waste retrieval. Compliance also is demonstrated by site personnel having collected and compiled information about the storage facility and waste to be retrieved. In addition, the plans and procedures for waste retrieval should reflect consideration of the information compiled about the facility, containers, and waste to be retrieved.

Supplemental References: None.

III. O. Treatment.

Transuranic waste shall be treated as necessary to meet the waste acceptance requirements of the facility receiving the waste for storage or disposal.

Objective:

The objective of this requirement is to emphasize that transuranic waste must be treated as necessary to meet the waste acceptance requirements of the storage, or disposal facility or facilities to which it will be transferred.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, treatment of waste was identified as an activity that presented potential risks to the public, workers, and the environment. Requirements that address the weaknesses and conditions that could lead to potential adverse impacts were found in external regulations (e.g., *Clean Air Act* or *RCRA*) or other DOE directives (e.g., 10 CFR Part 835, *Occupational Radiation Protection* or DOE O 360.1, *Training*). The Field Element Manager has a performance-oriented responsibility for ensuring that waste treatment is protective of the public, workers, and the environment (DOE M 435.1-1, Section I.2.F.(14)). The current requirement focuses attention on taking the treatment actions necessary to make waste acceptable for subsequent waste management steps.

The decision to treat waste, i.e., changing the physical or chemical character of the waste, can be driven by either dictated requirements or programmatic needs. Required treatment includes treatment necessary to comply with external regulations (e.g., RCRA, FFCA) or to render waste acceptable for transfer to another facility (i.e., to meet waste acceptance requirements). Waste acceptance requirements for a facility to which transuranic waste is transferred are required by DOE M 435.1-1, Section III.G. These requirements are based on safe handling of the waste and on regulatory compliance. During the development of DOE M 435.1, certain materials which represented a potential fire or explosion hazard were identified as being unacceptable for storage, leading to the need to treat waste composed of these materials so it can be accepted for storage. Waste treatment may range from actions as simple as sorting waste to remove materials which would make the waste unacceptable (e.g., aerosol cans), to more complex technologies such as incineration.

Storage Prohibitions. Manual requirements for transuranic waste storage include classes of items which are prohibited from storage because they represent potential fire or explosive hazards. The materials or classes of items which cannot be stored include dry nitrate-contaminated ion exchange resins, cellulosic material contaminated with strong oxidizers, reactive metals, pyrophoric materials, and volatile organics in high temperature areas. Wastes containing the

above-listed materials must be treated to remove or counteract the potential hazard. Nitrate-contaminated ion exchange resins can be stored wet or stabilized so they cannot react. Cellulosic materials can be oxidized under controlled conditions or the oxidizers can be neutralized. Reactive metals and pyrophoric materials can either be oxidized or stabilized (e.g., in concrete) to remove their hazards. Similarly, waste contaminated with volatile organics can be oxidized if it necessary to store the waste in an area of high heat.

Waste with No Path to Disposal. Available treatment options need to be evaluated before a waste is categorized as having no path to disposal, as discussed in Section I.2.F.(19). Application of appropriate treatment can potentially resolve waste acceptance issues for waste types such as:

- heterogenous wastes which contain unacceptable items (e.g., pressurized containers);
- liquid wastes which can be absorbed or solidified;
- wastes classified for security reasons because of shape;
- wastes containing high explosives; and
- wastes containing in excess of 50 ppm polychlorinated biphenyls.

Example: An activity generates an aqueous transuranic waste. In order to make the waste acceptable for storage and eventual disposal at WIPP, a study is performed to determine the most appropriate means of treatment. On the basis of the study, the liquid waste is solidified with an appropriate solidification agent so that the waste meets the acceptance criteria of both the storage facility and WIPP.

For defense waste, WIPP is the disposal facility, so evaluations of needed treatment generally need to consider the waste acceptance requirements of WIPP. However, there are some transuranic wastes for which treatment either is not currently available or will not solve the problem that makes the waste unacceptable for disposal at WIPP (e.g., non-defense waste). Such waste needs to be treated to the waste acceptance requirements of the storage facility to which it will be sent to ensure that it remains safe during the protracted storage period that will be required before disposal issues can be resolved.

Mixed Transuranic Waste. Treatment necessary to comply with agreements reached pursuant to the *Federal Facility Compliance Act of 1992* must also be considered in making treatment decisions. Although it was generally assumed that mixed transuranic waste would be sent to WIPP without treating for the RCRA-regulated component, site personnel need to ensure that

commitments made in the Site Treatment Plans and consent orders/agreements are met for both current and newly-generated transuranic wastes.

Treatment for Programmatic Reasons. The requirement to treat waste to meet the waste acceptance criteria of the appropriate storage or disposal facility is not intended to prohibit treatment for other reasons. Waste managers may elect to treat waste for programmatic reasons, but in so doing, must ensure that the waste will still meet the waste acceptance criteria of the facility(ies) to which it will be transferred. Programmatic reasons for treating waste may be to make more efficient use of the TRUPACT II transportation system and thereby reduce risk and cost associated with transportation to WIPP (see Section III.L.(2)), or to decrease the storage or disposal capacity needed.

> *Example: A site is generating significant amounts of compactable transuranic waste. Due to the time expected to pass before shipment to WIPP begins, waste projections indicate that additional onsite storage will be needed to accommodate the as-generated waste volumes. Results of a study indicate that use of a compactor will allow the site to store the projected wastes without building a new storage facility, and will also result in transportation cost savings because fewer TRUPACT II shipments to WIPP will be needed.*

Compliance with this requirement is demonstrated by the custodian of transuranic waste maintaining documentation which identifies the plans for treating waste, and maintaining the records that show waste was treated, if necessary, to meet the waste acceptance requirements of the storage or disposal facility to which it was transferred.

Supplemental References:

1. *Resource Conservation and Recovery Act of 1976,* as amended, October 21, 1986.

2. *Federal Facility Compliance Act of 1992*, as amended, October 6, 1992.

3. *Toxic Substances Control Act*, as amended, , October 11, 1976.

4. DOE, 1996. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 5, DOE/WIPP-069, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, April 1996.

III. P. Disposal.

Transuranic waste shall be disposed in accordance with the requirements of 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*.

Objective:

The objective of this requirement is to ensure transuranic waste is disposed of in a facility that meets the appropriate regulatory requirements and to establish Headquarters as the DOE authority for making compliance determinations for transuranic waste disposal facilities other than WIPP.

Discussion:

Responsibility for actions associated with transuranic waste disposal are addressed in the *Radioactive Waste Management Manual.* In DOE M 435.1-1, Section I.2.E., the Deputy Assistant Secretary is assigned responsibility for reviewing and approving certain transuranic waste disposal facility performance assessments. Paragraphs included in this portion of guidance explain the cases in which this applies. As discussed in DOE M 435.1-1, Section I.2.F.(15), the Field Element Manager of a site with a transuranic waste disposal facility is responsible for ensuring the safe disposal of transuranic waste, for reviewing performance assessments prior to submitting them to Headquarters, and for maintaining performance assessments.

Starting in the 1970s, the Department began storing waste that was suspected of being contaminated with transuranic isotopes at a concentration greater than 10 nCi per gram of waste. The concentration of 10 nCi/g (370 Bq/g) was an interim limit used pending completion of a technical basis for developing a limit. In 1982, the technical analyses for establishing a limit were discussed at an interagency workshop and the limit was changed to 100 nCi/g (3,700 Bq/g). Shortly after this workshop, the Environmental Protection Agency (EPA) proposed standards which included the 100 nCi/g limit for management and disposal of transuranic waste.

The EPA is responsible for developing generally applicable standards for protection of the environment from radioactive materials pursuant to authority granted by *Atomic Energy Act of 1954*, as amended, and the *Nuclear Waste Policy Act of 1982*, as amended. In 1985, the draft standards EPA proposed in 1982 were promulgated as the *Environmental Standards for the Management and Disposal of Spent Fuel, High-Level and Transuranic Radioactive Wastes,* 40 CFR Part 191. In 1987, the U.S. Court of Appeals for the First Circuit remanded Subpart B of the 1985 standards, "Environmental Standards for Disposal," for further consideration (*Natural Resources Defense Council, Inc.* v. *United States Environmental Protection Agency*, 824 F.2d 1258). In 1992, Congress reinstated a portion of the remanded disposal standards with the

passage of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended. Congress also directed EPA to resolve the issues that were the basis for the court remand and reissue the remaining disposal standards. On December 20, 1993, EPA issued the revised sections of the requirements. They became effective on January 19, 1994 (*58 FR 66398*).

Requirements Applicable to Disposal. The bulk of DOE's transuranic waste is related to defense activities and will ultimately be acceptable for disposal at WIPP. Consistent with this fact, most of the Department's focus on transuranic waste disposal has been on the development and opening of WIPP consistent with the requirements of 40 CFR Part 191. For WIPP, and any future facilities if they are developed, the requirements of 40 CFR Part 191 apply, including the revised individual protection and groundwater protection standards.

> *Example: A site determines that it must construct an enhanced engineered disposal facility for a small amount of transuranic waste that cannot be made to meet the WIPP waste acceptance criteria. Since the facility will operate after January 1994, it must comply with the January 1994 revisions to 40 CFR Part 191.*

However, for transuranic waste disposal facilities subject to 40 CFR Part 191 that operated prior to the January 1994 effective date, the older (1985) standards apply. In the Supplementary Information published in the 1993 Federal Register promulgating the revisions to the rule, EPA acknowledges that it previously informed the Department that the 1985 version of 40 CFR Part 191 applied to the Greater Confinement Disposal Facility (Nevada Test Site). The EPA further states that this determination is not changed by the *WIPP Land Withdrawal Act of 1992*, as amended, or the issuance of the revised regulation.

Departmental personnel should also note that the 40 CFR Part 191 regulations do not apply to disposal that occurred prior to promulgation of the regulations. The 1985 version of the regulations states under the applicability section of Subpart B, "Environmental Standards for Disposal," that the standards do not apply to waste disposed prior to the effective date of the rule. This excludes from the regulations waste that is colloquially known as "pre-1970 TRU waste", "suspect buried transuranic waste", and possibly by other names, if the waste is left in place. If the waste is exhumed, the waste becomes subject to the currently applicable regulations. However, as a good management practice, it is recommended that waste meeting the current definition of transuranic waste that was disposed of after 1970, but before 1994, be evaluated in accordance with the 1985 regulations.

> *Example: A site was in the middle of a three-year campaign to dispose of transuranic waste at the time 40 CFR Part 191 was promulgated in 1985. Consequently, some of the waste was disposed of before the effective date of the regulation and some was disposed of after. The site manager decides to include all of the transuranic waste in the performance assessment prepared under 40 CFR Part 191. Because the operation ended*

prior to 1994, the 1985 version of the regulations are applied as the performance measures in the assessment.

Approval Authority. Determination of compliance with the requirements of 40 CFR Part 191 depends on the facility being considered. In the *WIPP Land Withdrawal Act of 1992*, as amended, Congress assigned EPA the responsibility for issuing the standards discussed above and for certifying that WIPP meets the standards. In carrying out this responsibility, the EPA issued criteria by which they would evaluate the DOE certification application and published them as 40 CFR Part 194, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations; Final Rule*. The Department is responsible for submitting an application for compliance certification to the EPA. Subsequently, the EPA must determine if the Department complies with the requirements.

Sites other than WIPP are "regulated" by the implementing agency, in this case, DOE. As discussed in the General Requirements chapter of the *Radioactive Waste Management Manual* (DOE M 435.1-1, Section I.2.F.(15)), the Field Element Manager is responsible for reviewing and submitting a performance assessment to Headquarters. The Headquarters Deputy Assistant Secretary for Waste Management will establish a process similar to that used for low-level waste disposal facilities for reviewing and approving performance assessments, and also considers the following:

- General provisions including purpose, scope, definitions, communications, conditions of compliance, and alternative provisions;
- Compliance determinations including completeness and accuracy of compliance submissions and reference materials;
- General requirements that address inspections, quality assurance, models and computer codes, waste characterization, future state assumptions, expert judgment, and peer review;
- Containment requirements considering application of release limits, scope of performance assessments, consideration of drilling events in performance assessments, and results of performance assessments;
- Assurance requirements including active and passive institutional controls, monitoring, engineered barriers, and consideration of natural resources; and
- Individual and groundwater protection requirements that consider the protected individual, exposure pathways, underground sources of drinking water, and the scope and results of the performance assessment.

Example: The manager of a site that disposed of a small amount of transuranic waste ensures the development of a performance assessment that provides a reasonable expectation of meeting the performance measures in 40 CFR Part 191 for the onsite facility. Since the facility is not WIPP, following his review, the site manager submits the performance assessment to Headquarters for approval. The Deputy Assistant Secretary for Waste Management has previously assigned this task to a team that has developed a review plan that documents the criteria to be used. The team proceeds with the review and provides a recommendation back to the Deputy Assistant Manager who makes a final determination and documents it in a memorandum to the site manager.

Compliance with this requirement is demonstrated by timely completion of a technically-acceptable performance assessment that projects compliance with the standards contained in the appropriate version of 40 CFR Part 191 as discussed above. Another aspect of acceptable performance relative to this requirement is development and implementation of a review process that results in completing the compliance determination within one year of Headquarters' receipt of the performance assessment.

Supplemental References:

1. EPA, 1985. "Final Rule, 40 CFR Part 191, Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 50, No. 182, U.S. Environmental Protection Agency, Washington, D.C., September 19, 1985.

2. EPA, 1993. "Final Rule, 40 CFR Part 191, Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," *Federal Register*, Vol. 58, No. 242, U.S. Environmental Protection Agency, Washington, D.C., December 20, 1993.

3. EPA, 1996. "40 CFR Part 194, Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations," *Federal Register*, Vol. 61, No. 28, U.S. Environmental Protection Agency, Washington, D.C., February 9, 1996.

4. EPA, 1996. *Compliance Application Guidance for 40 CFR Part 194*, EPA 402-R-95-014, U.S. Environmental Protection Agency, Washington, D.C., March 29, 1996.

5. *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended, October 30, 1992.

6. *Nuclear Waste Policy Act of 1982,* as amended, January 7, 1983.

7. *Atomic Energy Act of 1954*, as amended, 42 U.S.C. 2011 et seq, 1954.

III. Q. Monitoring.

The following requirements are in addition to those in Chapter I of this Manual:

(1) All Waste Facilities. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, and flammable or explosive mixtures of gases. Facility monitoring programs shall include verification that passive and active control systems have not failed.

Objective:

The objective of this requirement is to specify minimum parameters for which information will be routinely collected and analyzed for the purpose of anticipating or identifying undesirable conditions in the management of transuranic waste.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, the hazards and safety analyses identified timely monitoring of radioactive waste management facilities as an effective means of mitigating numerous weaknesses and conditions associated with all phases in the life cycle of waste management. An analysis of existing Departmental requirements for environmental monitoring in DOE 5400.1 and DOE 5400.5 found that they were applicable to all radioactive waste types and all radioactive waste management facilities. Many of the individual conditions evaluated in the safety and hazards analysis which warranted monitoring are already addressed due to implementation of these Order requirements. These two DOE Orders are invoked by DOE M 435.1-1, Section I.1.E.(7).

However, while the general environmental monitoring program and the environmental monitoring plans mandated by DOE 5400.1 and DOE 5400.5 are adequate for most circumstances, requirements have been included in DOE M 435.1-1 to require identification of specific warning signs of impending conditions that could lead to releases, especially for storage of liquid transuranic waste. Requirements III.Q.(1) and III.Q.(2) address these aspects of additional monitoring for transuranic waste facilities.

Parameters Specified. The minimum parameters specified in the requirement (temperature, pressure, radioactivity in effluents, flammable/explosive mixtures of gases) were selected based on their potential significance in predicting and identifying undesirable conditions. Each facility's radioactive waste management basis should include an evaluation of the applicability and significance of the minimum parameters. This evaluation also needs to consider additional parameters to be sampled or monitored to ensure the protection of the public health, the

environment, and the workers. If a minimum parameter specified in the requirement is deemed to be not applicable in any way to the active operation of that facility, then that justification should be included in the radioactive waste management basis and when approved, constitutes an exemption to the Manual.

The parameters need to be sampled or monitored with a frequency that is consistent with the need to detect changes in facility performance. The accuracy and precision of measurement required is dictated by the expected variations in the parameters and the level of accuracy and precision needed to identify problems. The monitoring frequency for specific parameters is likewise determined based on the possible time variation of the parameter and the response time required to take mitigating action. For facilities that release radioactivity in effluents, frequent monitoring or continuous monitoring should be considered.

> *Example: A tank is used to store liquid transuranic waste. In evaluating the potential for releases from the tank, it is determined that waste temperature, head space pressure, and radioactivity in the ventilation exhaust must be continuously monitored. An organics sniffer is used on a weekly basis to check for flammable/explosive mixtures of gases in the tank. There are no liquid effluents, so no sampling or monitoring is required.*

The verification that controls and systems are functioning properly is based upon the nature of the transuranic waste management activity and the potential impact resulting from a failure. Verification of active control systems for sampling and monitoring critical facility parameters may require frequent visual inspections or performance testing. Passive controls such as the floor and curbing in a storage facility may only require physical inspection once every year. Verification activities are part of the radioactive waste management basis and are to be documented appropriately.

All transuranic waste management facilities are required to apply the sampling or monitoring requirement for the specified parameters using a graded approach. As previously noted, the methods used and the frequency should be commensurate with the significance of a change in the parameter. This graded approach can extend to determining that it is inappropriate or unnecessary to monitor or sample for specific parameters, but the basis for such a determination needs to be documented.

> *Example: A building is used for the storage of packaged transuranic waste. Based on the auditable safety analysis, sampling and monitoring for the minimum specified parameters are applied in a graded manner depending on the parameter. The facility ventilation system is equipped with a continuous monitor and a sampler. Radioactivity in liquid effluent and pressure are not monitored or sampled because the parameters do not apply to the facility. The inspection procedures for the facility specify that personnel should note whether the temperature in the building is within a range of 55 to 85 degrees*

Fahrenheit. In addition, procedures require personnel to record visual observations of the drums, including whether there is any bulging that indicates pressurization.

Compliance with this requirement is demonstrated if monitoring or sampling for the stated parameters is performed for all facilities with an accuracy, precision, and frequency consistent with timely identification of developing problems and a justification exists in the approved radioactive waste management basis for those specified parameters which are not monitored or sampled.

Supplemental References:

1. DOE, 1988. *General Environmental Protection Program,* DOE 5400.1, U.S. Department of Energy, Washington, D.C., November 9, 1988.

2. DOE, 1990. *Radiation Protection of the Public and the Environmental,* DOE 5400.5, U.S. Department of Energy, Washington, D.C., February 8, 1990.

III. Q.(2) Stored Wastes. All transuranic wastes in storage shall be monitored, as prescribed by the appropriate facility safety analysis, to ensure the wastes are maintained in safe condition.

Objective:

The objective of this requirement is to ensure that the results of safety analyses performed as part of the authorization of transuranic waste facility operations are appropriately translated into monitoring requirements for waste storage so conditions that could lead to exposure of the public or workers, or releases to the environment are detected and mitigated.

Discussion:

During the development of DOE O 435.1 and DOE M 435.1-1, monitoring at radioactive waste management facilities was identified as an effective mitigation of numerous weaknesses and conditions associated with all phases of the life-cycle of waste management. An analysis of existing Departmental requirements for environmental monitoring in DOE 5400.1 and DOE 5400.5 found that they were applicable to all radioactive waste types and all radioactive waste management facilities. Many of the individual conditions that warranted monitoring that were evaluated in the safety and hazards analysis are mitigated due to the implementation of these Order requirements. Therefore, DOE M 435.1-1, Section I.1.E.(7) requires that these two DOE Orders be implemented for environmental monitoring of radioactive waste management facilities.

While the environmental monitoring mandated by DOE 5400.1 and DOE 5400.5 is adequate to detect environmental releases, it was determined that due to the long storage times that occur with transuranic waste, monitoring of additional systems or parameters was needed. The DOE regulation governing radiation exposure of workers (10 CFR Part 835), was also identified as a source of requirements that would require that a set of controls be put in place to protect workers from radiation exposure.

> *Example: Transuranic waste is stored in a building which contains a change room used by waste management workers. Access to the change room requires workers to pass through the area where the waste is stored. The health physics staff takes dose rate readings along the face of the stored transuranic waste, then cordons off a radiological control area that minimizes exposure to staff that must pass through the building.*

Additional systems or parameters that could warn of impending conditions that could lead to worker exposure or releases to the environment may be indicated in the safety analyses performed for transuranic waste management facilities. Some of the monitoring that safety analyses indicate is needed may be also addressed minimum requirements in the other subparagraphs of this monitoring requirement.

The *Nuclear Safety Analysis Reports* Order (DOE 5480.23) and related standards (DOE-STD-3009-93, DOE-STD-1027-92, DOE-EM-STD-5502-04) and the *Facility Safety* Order (DOE O 420.1) provide information on the hazard categorization of facilities and the safety analyses to be performed. Through the conduct of safety analyses, whether they are formal safety analysis reports or auditable safety analyses, facility personnel identify the quantity and form of radioactive and/or hazardous material to be handled at the facility and the operations for managing the waste. The safety analysis establishes a basis for defining the acceptable operations envelope for the facility, and provides the basis for technical safety requirements (TSRs). The technical safety requirements may include requirements for monitoring, however, facility personnel are to also review the safety analysis to determine if the analyses indicate other monitoring that would be prudent.

> *Example: An auditable safety analysis is performed as part of the startup of a transuranic waste storage facility. The safety analysis indicates that a monitoring and sampling system is required on the building exhaust system to ensure releases do not endanger workers, the public, or the environment. Site personnel decided that alpha monitors will be installed in the waste storage bays, in addition to the monitor that is on the building ventilation system, consistent with the defense-in-depth philosophy.*

The safety analyses may also indicate the need for routine inspection of waste packages in storage. Inspections to be performed on waste packages in storage are addressed by DOE M 435.1-1, Section III.N and are discussed in the guidance for that requirement.

Compliance with this requirement is demonstrated if the monitoring requirements in the facility procedures include, at a minimum, monitoring the systems and parameters as indicated by the safety analysis.

Supplemental References:

1. DOE, 1994. *DOE Limited Standard: Hazard Baseline Documentation*, DOE-EM-STD-5502-04, U.S. Department of Energy, Washington, D.C., August 1994.

2. DOE, 1992. *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C., April 10, 1992.

3. DOE, 1992. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, U.S. Department of Energy, Washington, D.C., December 1992.

4. DOE, 1993. *SAR Preparation Guide*, DOE-STD-3009-93, U.S. Department of Energy, Washington, D.C., 1993.

III. Q.(3) Liquid Waste Storage Facilities. For facilities storing liquid transuranic waste, the following shall also be monitored: liquid level and/or waste volume, and significant waste chemistry parameters.

Objective:

The objective of this requirement is to ensure monitoring of parameters that indicate the quantity of liquid transuranic waste stored in tanks so that changes can be promptly checked to determine if they indicate leakage, overfilling, or other problems. The objective of this requirement also includes tracking of the chemical characteristics of the waste to anticipate and avert undesirable storage conditions.

Discussion:

This requirement specifies additional parameters to be monitored at facilities storing liquid transuranic waste. In developing the requirements for DOE O 435.1 and DOE M 435.1-1, a hazards analyses identified releases resulting from failed containment or from overfilling liquid waste storage tanks as hazards that can result in exposure of workers or the public and releases to the environment. The requirement addresses the operation of monitoring systems to detect storage tank or transfer equipment failure that is of sufficient magnitude to cause a detectable volume change, as well as volume increases that could lead to overfilling of tanks. The

monitoring capability should be coupled with operational devices such as automatic shutoffs and bypasses and alarms that will alert operators that action is needed to prevent or mitigate a release. Regardless of the radiological hazard of the waste being stored, leak detection equipment and inspection of catch basins for liquid waste storage facilities should be included in the monitoring program, consistent with the requirements in DOE 5480.22, to prevent unplanned releases of liquid waste in storage.

Liquid Level or Waste Volume. Some changes in liquid level or waste volume can occur normally due to slight changes in temperature or pressure. This requirement addresses measuring liquid level or waste volume in a storage tank for the purpose of prompt detection of acute releases (releases that are detectable visually or by some other gross indicator) and more chronic releases that become apparent over a time frame of hours or days.

> *Example. A large diameter liquid transuranic waste storage tank includes a mechanical level indicator that is read and recorded daily. The level indicator remains stable for six months following the last addition of waste to the tank. The level indicator readings then begin to show a downward trend that totals two inches over a two week period. The level indicator change alerts operators of a potential problem that requires further investigation.*

Surface level is a relatively straightforward parameter to monitor for detection of leakage from a liquid waste storage system. In general, the surface level in a storage tank is an appropriate indicator of waste volume. However, operations and mechanisms that could change the volume in a tank must be considered to ensure all unexplainable level changes are investigated and to discount explainable level changes.

Gas generation and evaporation, as well as intentional additions to and removals from the storage tanks, must be accurately accounted for if the waste liquid level (or volume) is to be used to monitor for leakage. Also, consideration needs to be given to the separate monitoring of the liquid fraction and sludge or solid fraction present in the tank, if layering of the waste is present.

> *Example: In the tank in the example above, an unexpected chemical reaction generates gas that is trapped within the waste matrix or under a semipermeable layer of waste that retards percolation of the gas to the surface of the waste. Consequently, there is an increase in the surface level of the waste. Over time, the gas is released and the waste volume returns to its normal level. Although the change in liquid level in the tank did not appear to be a problem once the gas was released, the generation of gas is identified as an issue that needs further investigation.*

Chemical Characteristics. Experience with situations threatening confinement of liquid radioactive waste in storage tanks led to the part of the requirement focused on monitoring

chemical characteristics. Chemical characteristics that are not compatible with the material of construction of waste tanks or transfer equipment often presage containment failure. The frequency of monitoring and the identification of significant tank chemistry parameters should be determined on a facility-, waste-, and tank-specific basis. A recommended program for monitoring and managing waste chemistry as it relates to tank corrosion is described in *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks* (BNL-UC-406). Tank waste chemistry also is to be monitored for the potential generation of flammable or explosive gases. Once waste has been characterized and shown to be in essentially a steady state relative to gas generation, it is the addition of new waste that needs to be most closely watched. Selection of parameters is based on the need to protect the public health, the environment, and workers. Monitoring is performed to provide statistically valid information of the relevant tank chemistry and any detected changes in the chemistry of the tank.

> *Example: Some very minor volumes of laboratory spill waste are planned to be added to liquid storage tank YTR. Tank YTR is made of carbon steel and has been in service since 1978. The pH of the spill waste is measured, then adjusted to a pH of 12 to meet the waste acceptance requirements for waste transfers to the tank. The pH testing of the waste is part of the routine monitoring for tank YTR.*

Graded Approach. A graded approach needs to be applied to implementation of this requirement for monitoring liquid wastes in storage. The first consideration for a graded approach is that monitoring parameters and frequencies for liquid waste storage tanks should be specific for each tank. Also, the frequency of monitoring is selected to detect changes commensurate with the potential failure mechanisms and resulting risks of the specific waste being stored.

> *Example: A highly radioactive acidic waste is stored in a stainless steel tank. The tank is at capacity so no waste additions are planned. Monitoring consists of a permanently installed liquid level detector and monthly monitoring of tank pH and chlorine compounds which could cause corrosion. Another tank constructed of carbon steel is routinely used for receipt of new waste. In addition to monitoring the liquid level in the tank and tracking additions and removals, the tank chemistry is checked weekly for pH to ensure that the waste is maintained at a high pH.*

Compliance with this requirement is demonstrated by developing operational procedures for monitoring liquid transuranic waste storage tank liquid level, waste volume, and tank chemistry so that waste volume or chemistry changes are detected in a time frame that will allow implementation of corrective measures to limit public and worker doses and to mitigate unplanned releases of stored liquid waste.

Supplemental References:

1. DOE, 1992. *DOE Fundamentals Handbook, Chemistry*, DOE-HDBK-1015, Module 2: "Corrosion," U.S. Department of Energy, Washington, D.C., June 1992.

2. DOE, 1993. *DOE Fundamentals Handbook, Material Science*, DOE-HDBK-1017, Module 2: "Properties of Metals," U.S. Department of Energy, Washington, D.C., January 1993.

3. DOE, 1997. *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, BNL-UC-406, Brookhaven National Laboratory, Upton, NY, January 1997.

4. DOE, 1992. *Technical Safety Requirements*, DOE 5480.22, U.S. Department of Energy, Washington, D.C., February 25, 1992.

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discussions with representatives of the NRC staff regarding proposed final SRP Chapter 19, Regulatory Guide DG–1061, and use of uncertainty versus point values in the PRA-related decisionmaking process.

10:15 A.M.–12:00 Noon: Operating Events at Oconee Nuclear Power Plant Units 1 and 2 (Open)—The Committee will hear presentations by and hold discussions with representatives of the NRC staff regarding the results of the investigation performed by an Augmented Inspection Team (AIT) of the June 20 and 23 event at Oconee Unit 1 involving failure of emergency electrical power supply, and of the April 22, 1997 event at Oconee Unit 2 that involved inoperability of the high pressure injection pump.

1:00 P.M.–3:00 P.M.: Capability and Application of the EPRI Checkworks Code (Open)—The Committee will hear presentations by and hold discussions with representatives of the NRC staff and Electric Power Research Institute (EPRI) regarding the capability and application of the EPRI Checkworks Code.

3:15 P.M.–3:45 P.M.: Future ACRS Activities (Open)—The Committee will discuss the recommendations of the Planning and Procedures Subcommittee regarding items proposed for consideration by the full Committee during future meetings.

3:45 P.M.–4:00 P.M.: Reconciliation of ACRS Comments and Recommendations (Open)—The Committee will discuss responses from the NRC Executive Director for Operations (EDO) to comments and recommendations included in recent ACRS reports, including the EDO response to the October 10, 1997 ACRS report related to the differing professional opinion pertaining to steam generator tube integrity.

4:00 P.M.–4:15 P.M.: Election of ACRS Officers For CY 1998 (Open)—The Committee will elect the Chairman and Vice Chairman for the ACRS, and Member-at-Large for the Planning and Procedures Subcommittee for CY 1998.

4:15 P.M.–7:00 P.M.: Preparation of ACRS Reports (Open)—The Committee will continue its discussion of proposed ACRS reports on matters considered during this meeting.

Saturday, December 6, 1997

8:30 A.M.–9:00 A.M.: Report of the Planning and Procedures Subcommittee (Open/Closed)—The Committee will hear a report of the Planning and Procedures Subcommittee on matters related to the conduct of ACRS business, qualifications of candidates nominated for appointment to the ACRS, agenda for the planning meeting, and organizational and personnel matters relating to the ACRS.

[Note: A portion of this session may be closed to discuss organizational and personnel matters that relate solely to the internal personnel rules and practices of this Advisory Committee, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.]

9:00 A.M.–4:00 P.M. (12:00–1:00 P.M. Lunch): Preparation of ACRS Reports (Open)—The Committee will continue its discussion of proposed ACRS reports on matters considered during this meeting.

4:00 P.M.–4:30 P.M.: Miscellaneous (Open)—The Committee will discuss matters related to the conduct of Committee activities and matters and specific issues that were not completed during previous meetings, as time and availability of information permit.

Procedures for the conduct of and participation in ACRS meetings were published in the **Federal Register** on September 4, 1997 (62 FR 46782). In accordance with these procedures, oral or written views may be presented by members of the public, including representatives of the nuclear industry, electronic recordings will be permitted only during the open portions of the meeting, and questions may be asked only by members of the Committee, its consultants, and staff. Persons desiring to make oral statements should notify Mr. Sam Duraiswamy, Chief, Nuclear Reactors Branch, at least five days before the meeting, if possible, so that appropriate arrangements can be made to allow the necessary time during the meeting for such statements. Use of still, motion picture, and television cameras during this meeting may be limited to selected portions of the meeting as determined by the Chairman. Information regarding the time to be set aside for this purpose may be obtained by contacting the Chief of the Nuclear Reactors Branch prior to the meeting. In view of the possibility that the schedule for ACRS meetings may be adjusted by the Chairman as necessary to facilitate the conduct of the meeting, persons planning to attend should check with the Chief of the Nuclear Reactors Branch if such rescheduling would result in major inconvenience.

In accordance with Subsection 10(d) P.L. 92–463, I have determined that it is necessary to close portions of this meeting noted above to discuss matters that relate solely to the internal personnel rules and practices of this Advisory Committee per 5 U.S.C. 552b(c)(2) and to discuss information the release of which would constitute a clearly unwarranted invasion of personal privacy per 5 U.S.C. 552b(c)(6).

Further information regarding topics to be discussed, whether the meeting has been canceled or rescheduled, the Chairman's ruling on requests for the opportunity to present oral statements and the time allotted therefor, can be obtained by contacting Mr. Sam Duraiswamy, Chief, Nuclear Reactors Branch (telephone 301/415–7364), between 7:30 A.M. and 4:15 P.M. EST.

ACRS meeting agenda, meeting transcripts, and letter reports are available for downloading or reviewing on the internet at http://www.nrc.gov/ACRSACNW.

The ACRS meeting dates for Calendar Year 1998 are provided below:

ACRS Meeting No.	1998 ACRS Meeting Date
	Jan.—No Meeting.
448	Feb. 5–7, 1998.
449	Mar. 2–4, 1998.
450	Mar. 5–7, 1998. (Safety Research Program)
451	Apr. 2–4, 1998.
452	Apr. 30–May 2, 1998.
453	June 3–5, 1998.
454	July 8–10, 1998.
	Aug.—No Meeting.
455	Sept. 2–4, 1998.
456	Oct. 1–3, 1998.
457	Nov. 5–7, 1998.
458	Dec. 3–5, 1998.

Dated: November 14, 1997.

Andrew L. Bates,

Advisory Committee Management Officer.

[FR Doc. 97–30526 Filed 11–19–97; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL PROTECTION AGENCY

Joint NRC/EPA Guidance on Testing Requirements for Mixed Radioactive and Hazardous Waste

AGENCIES: Environmental Protection Agency and Nuclear Regulatory Commission.

ACTION: Publication of Final Joint Guidance on the Testing Requirements for Mixed Waste.

SUMMARY: The Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA) are jointly publishing herein final guidance on the testing requirements for mixed radioactive and hazardous waste (mixed waste). NRC and EPA began development of this guidance in 1987 and a draft was completed in 1989. EPA's adoption of the Toxicity Characteristic Leaching Procedure (TCLP) in 1990 required the agencies to substantially revise the guidance. The agencies issued a draft for public comment on March 26, 1992. A public meeting was held on April 14, 1992, in Washington, D.C., to solicit oral comments on the draft guidance document. The comment period ended on May 26, 1992. NRC and EPA received more than 700 requests for copies of the draft guidance document and NRC received approximately 100 written comments from 20 individuals and groups, including comments resulting from a review of the guidance by the U.S. Department of Energy. NRC and EPA staffs have incorporated the appropriate comments into the final guidance.

The guidance emphasizes the use of process knowledge, whenever possible, to determine if a waste is hazardous as a way to avoid unnecessary exposures to radioactivity. The guidance also provides guidelines for generators wishing to rely on process knowledge as the basis for evaluating their waste.

The guidance offers two strategies for helping to maintain radiation exposures As Low As is Reasonably Achievable (ALARA) if testing is required. These strategies are the use of a sample size of less than 100 grams, as long as the resulting test is sufficiently sensitive to measure the constituents of interest at the regulatory levels prescribed in the TCLP, and the use of surrogate materials, as long as they are chemically identical to the mixed waste and faithfully represent the hazardous constituents in the waste mixture.

The guidance also discusses other allowable sampling and testing procedures, such as representative drum sampling, or sampling from drums containing lower concentrations of radioactive material, as long as the chemical contents are identical to those found in the drums with higher concentrations of radioactive material.

FOR FURTHER INFORMATION CONTACT: Dominick A. Orlando, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C., 20555, telephone (301) 415-6749 or Newman Smith, Permits and State Programs Division, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C., 20460, telephone (703) 308-8757.

Dated at Rockville, MD and Washington, DC this 7th day of November, 1997.

For the U.S. Nuclear Regulatory Commission.

Carl J. Paperiello,

Director, Office of Nuclear Material Safety and Safeguards.

For the U.S. Environmental Protection Agency.

Elizabeth Cotsworth,

Acting Director, Office of Solid Waste.

SUPPLEMENTARY INFORMATION:

Clarification of RCRA Hazardous Waste Testing Requirements for Low-Level Radioactive Mixed Waste—Final Guidance

Disclaimer: The policies discussed in this document are not final Agency actions, but are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. The Environmental Protection Agency and Nuclear Regulatory Commission may follow the guidance, or act at variance with the guidance, based on an analysis of specific site circumstances. The agencies also reserve the right to change the guidance at any time, without public notice.

ACRONYMS/ABBREVIATIONS USED IN THIS GUIDANCE

Acronym/abbreviation	Definition
AEA	Atomic Energy Act.
ALARA	As Low As is Reasonably Achievable.
BDAT	Best Demonstrated Available Technology.
CFR	Code of Federal Regulations.
EP	Extraction Procedure (toxicity test).
EPA	Environmental Protection Agency.
FR	Federal Register.
HSWA	Hazardous and Solid Waste Amendments.
LDR	Land Disposal Restrictions.
NRC	Nuclear Regulatory Commission.
OSWER	Office of Solid Waste and Emergency Response.
RCRA	Resource Conservation and Recovery Act.
SW-846	Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods.
TC	Toxicity Characteristic.
TCLP	Toxicity Characteristic Leaching Procedure.
TSDF	Treatment, Storage or Disposal Facility.
WAP	Waste Analysis Plan.

I. Background

Mixed waste is defined as waste that contains both hazardous waste subject to the requirements of the Resource Conservation and Recovery Act (RCRA) and source, special nuclear, or by-product material subject to the requirements of the Atomic Energy Act (AEA).[1] This guidance addresses testing activities related to mixed low-level waste (LLW), which is a subset of mixed waste.[2] The term "mixed waste," for the purposes of this document, will refer to mixed LLW. Additional information on the testing of hazardous wastes, which could apply to both mixed LLW and other types of mixed waste (e.g., high-level and transuranic mixed waste), is found in Appendix A. The information below is intended for use by Nuclear Regulatory Commission (NRC) licensees that may not be familiar with the hazardous waste characterization and testing requirements that apply to mixed waste. The guidance assumes that the reader is familiar with the NRC's regulations and regulatory framework for the management of radioactive material and focuses on compliance with the Environmental Protection Agency's (EPA's) requirements for the management of hazardous waste. Although it is written for commercial mixed waste generators, the guidance may also be useful for Federal facilities that generate mixed waste.

Users of this guidance should have a good understanding of how mixed waste is defined (see above), and what authority, or authorities, regulate mixed waste testing activities. The hazardous component of mixed waste is regulated by EPA in those States where EPA implements the entire RCRA Subtitle C hazardous waste program (i.e., unauthorized States). Currently, EPA regulates mixed waste in Alaska, Hawaii, Iowa, Puerto Rico, the Virgin Islands, and American Samoa. In most instances mixed waste is regulated by State governments. Thirty-nine States and one territory (Guam) have been delegated authority by EPA to implement the base RCRA hazardous waste program and to regulate mixed waste activities (see 51 *FR* 24504, July 3, 1986, and Appendix B). These States are referred to as "mixed waste authorized States." Nine additional States are authorized for the RCRA base hazardous waste program but have not been delegated authority by EPA to

[1] See 42 U.S.C. §6903 (41), added by the Federal Facility Compliance Act of 1992 (FFCA).

[2] See revised *Guidance on the Definition and Identification of Commercial Low-Level Radioactive and Hazardous Waste and Answers to Anticipated Questions*, October 4, 1989.

regulate mixed waste.[3] In these States mixed waste is not regulated by EPA, but may be regulated by States under the authority of State law. It is important that licensees contact the State hazardous waste agencies in authorized States to determine the specific testing, analysis, and other hazardous waste requirements that may apply to mixed waste managed in their State, because their State may have more stringent requirements than the Federal requirements discussed in this guidance.

This guidance describes:

(1) The current regulatory requirements for determining if a waste is a RCRA hazardous waste;

(2) The role of waste knowledge for hazardous waste determinations;

(3) The waste analysis information necessary for proper treatment, storage, and disposal of mixed waste; and,

(4) The implications of the RCRA land disposal restrictions (LDRs) on the waste characterization and analysis requirements.

This information should be useful for: (1) radioactive waste generators, who must determine if their waste is a RCRA hazardous waste, and therefore a mixed waste; (2) for those generators storing mixed waste on-site in tanks, containers or containment buildings for longer than 90 days, that consequently become responsible for complying with RCRA and NRC storage requirements; and (3) those facilities that accept mixed waste for off-site treatment, storage, or disposal.

Generators and/or treatment, storage, and disposal facilities (TSDFs) handling wastes under RCRA must characterize their waste for several purposes:

(1) To determine if their waste is a hazardous waste (40 CFR 262.11);

(2) To comply with general waste analysis requirements for new or permitted TSDFs, for TSDFs operating under interim status, and for certain generators that treat land disposal prohibited wastes in 40 CFR 264.13, 265.13 and 268.7, respectively. These analysis requirements include:

(a) chemical/physical analysis of a representative sample (and/or, in some cases, use waste knowledge (see below); and,

(b) preparation of a waste analysis plan.

(3) To meet the waste analysis requirements that apply to the specific waste management methods in 40 CFR 264.17, 264.314, 264.341, 264.1034(d), and 268.7;

(4) To ensure, prior to land disposal, that the restricted waste meets the required treatment standard (40 CFR 268.7).[4]

This guidance addresses the need for chemical analysis of mixed wastes to meet these purposes. The guidance also emphasizes ways in which unnecessary testing of mixed waste may be avoided. This is important when handling mixed waste, since each sampling, workup, or analytical event may involve an incremental exposure to radiation. This guidance encourages mixed waste handlers to use waste knowledge, such as process knowledge, where possible, in making RCRA hazardous waste determinations involving mixed waste. It also encourages the elimination of redundant testing by off-site treatment and disposal facilities, where valid generator-supplied, and certified, data are available.

Because mixed waste testing may pose the possibility of increased radiation exposures, this guidance also describes methods by which individuals who analyze mixed waste samples may reduce their occupational radiation exposure and satisfy the intent of the RCRA testing requirements. Testing to determine whether wastes are hazardous under the RCRA toxicity characteristic may pose special concerns which are examined in Section III of this guidance.

All of the activities described in this guidance are subject to the requirements of both the AEA and RCRA. The focus of this guidance is the RCRA requirements. NRC and NRC Agreement State licensees are authorized to receive, possess, use (which includes storing, sampling, testing, and treating), and dispose of AEA-licensed materials. NRC licensees handling mixed waste should ensure that their RCRA hazardous waste testing activities are consistent with NRC, or Agreement State, regulations and license conditions. Flexibility in the RCRA requirements is emphasized so that the As Low As is Reasonably Achievable (ALARA) concept can be incorporated into the mixed waste testing activities.[5] If other AEA requirements, or RCRA requirements are difficult to meet in a specific mixed waste management situation, licensees should seek resolution by requesting license amendments, approval of modifications to their RCRA permits or interim status Part A applications, or resolution under both authorities.

Section 1006(a) of RCRA states "Nothing in this Act shall be construed to apply to (or authorize any State, interstate, or local authority to regulate) any activity or substance which is subject to * * * the Atomic Energy Act of 1954 * * * except to the extent that such application (or regulation) is not inconsistent with the requirements of such Acts." If a resolution cannot be achieved through the flexibility provided by the two regulatory frameworks, then and only then, should licensees seek resolution under Section 1006(a) of RCRA. Licensees should note that, if an inconsistency exists, relief will be limited to that specific RCRA requirement, and that the determination of an inconsistency would not relieve the licensee from all other RCRA requirements. Section 1006(a) and radiological hazard considerations are addressed more fully in Sections III and IV of this guidance. NRC licensees should also include the necessary flexibility in their RCRA permit waste analysis plans to accommodate the sampling and testing required to meet AEA requirements.

II. Use of Waste Knowledge for Hazardous Waste Determinations

The use of waste knowledge by a generator and/or a TSDF to characterize mixed waste is recommended throughout this document to eliminate unnecessary or redundant waste testing. EPA interprets "waste knowledge" or "acceptable knowledge" of a waste broadly to include, where appropriate:

- "Process knowledge";
- Records of analyses performed by generator or TSDF prior to the effective date of RCRA regulations; or,
- A combination of the above information, supplemented with chemical analysis.

Process knowledge refers to detailed information on processes that generate wastes subject to characterization, or to detailed information (e.g., waste analysis data or studies) on wastes generated from processes similar to that which generated the original waste. Process knowledge includes, for example, waste analysis data obtained by TSDFs from the specific generators that sent the waste off-site, and waste analysis data obtained by generators or TSDFs from other generators, TSDFs or areas within a facility that test chemically identical wastes.[6]

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[3] The RCRA base hazardous waste program is the RCRA program initially made available for final authorization and includes Federal regulations up to July 26, 1982. However, authorized States have revised their programs to keep pace with Federal program changes that have taken place after 1982 in accordance with EPA regulation.

[4] Refer to Appendix A for specific EPA regulations pertaining to (1)–(4).

[5] ALARA, codified in 10 CFR Part 20, refers to the practice of maintaining all radiation exposures, to workers and the general public, as low as is reasonably achievable.

[6] For a more detailed discussion on process knowledge, see Section 1.5 in "Waste Analysis at

Continued

Waste knowledge is allowed by RCRA regulations for the following hazardous waste characterization determinations:

- To determine if a waste is characteristically hazardous (40 CFR 262.11(c)(2)) or matches a RCRA listing in 40 CFR Part 261, Subpart D (40 CFR 262.11(a) and (b));
- To comply with the requirement to obtain a detailed chemical/physical analysis of a representative sample of the waste under 40 CFR 264.13(a);
- To determine whether a hazardous waste is restricted from land disposal (40 CFR 268.7(a)); and,
- To determine if a restricted waste the generator is managing can be land disposed without further treatment (see the generator certification in 40 CFR 268.7(a)(3) and information to support the waste knowledge determination in 40 CFR 268.7(a)(6)).

Hazardous waste, including mixed waste, may be characterized by waste knowledge alone, by sampling and laboratory analysis, or a combination of waste knowledge, and sampling and laboratory analysis. The use of waste knowledge alone is appropriate for wastes that have physical properties that are not conducive to taking a laboratory sample or performing laboratory analysis. As such, the use of waste knowledge alone may be the most appropriate method to characterize mixed waste streams where increased radiation exposures are a concern. Mixed waste generators should contact the appropriate EPA regional office to determine whether they possess adequate waste knowledge to characterize their mixed waste.

III. Determinations by Generators That a Waste Is Hazardous

A solid waste is a RCRA hazardous waste if it meets one of two conditions: (1) the waste is specifically "listed" in 40 CFR Part 261, Subpart D, or; (2) the waste exhibits one of the four "characteristics" identified in 40 CFR Part 261, Subpart C. These characteristics are:

- Ignitability;
- Corrosivity;
- Reactivity; or,
- Toxicity.

(a) Listed Hazardous Wastes

Generators of waste containing a radioactive and solid waste component must establish whether the solid waste component is a RCRA hazardous waste. Determinations of whether a waste is a listed hazardous waste can be made by comparing information on the waste stream origin with the RCRA listings set forth in 40 CFR Part 261, Subpart D. These listings are separated into three major categories or lists, and are identified by EPA hazardous waste numbers. Most hazardous waste numbers are associated with a specific waste description, specific processes that produce wastes, or certain chemical compounds. For example, K103 waste is defined as "process residues from aniline extraction from the production of aniline." A generator who produces such residues should know, without any sampling or analysis, that these wastes are "listed" RCRA hazardous wastes by examining the K103 hazardous waste description in the hazardous waste lists. Other hazardous waste numbers describe wastes generated from generic processes that are common to various industries and activities. These wastes are referred to as hazardous wastes from nonspecific sources. Radioactively contaminated spent solvents are the most likely mixed wastes to be nonspecific source listed wastes. For example, a generator using one of the F002 halogenated solvents (e.g., tetrachloroethylene, trichloroethylene, and chlorobenzene, etc.) to remove paint from a radiologically contaminated surface, can determine that this waste is a listed RCRA hazardous waste by examining the F002 waste definition for the solvent type, and for a solvent mixture/blend, the percent solvent by volume.

In addition to wastes that are specifically listed as hazardous, the "derived from" and "mixture" rules state that any solid waste derived from the treatment, storage, or disposal of a listed RCRA hazardous waste, or any solid waste mixed with a listed RCRA hazardous waste, respectively, is itself a listed RCRA hazardous waste until delisted (see 40 CFR 261.3).[7] (Note that soil and debris can be managed as hazardous wastes if they contain listed hazardous wastes or they exhibit one or more hazardous waste characteristics. See hazardous debris definition in 40 CFR 268.2.)

Exceptions to the "mixture rule" and "derived from" rules exist for certain solid wastes. For example, wastewater discharges subject to Clean Water Act permits, under certain circumstances, are not RCRA hazardous (see 40 CFR 261.3(a)(2)(iv)). Also, hazardous wastes which are listed solely for a characteristic identified in Subpart C of 40 CFR Part 261 (e.g., a F003 spent solvent which is listed only because it is ignitable) are not considered hazardous wastes when they are mixed with a solid waste and the resultant mixture no longer exhibits any characteristic of a hazardous waste (see 40 CFR 261.3(a)(2)(iii)). Likewise, waste pickle liquor sludge "derived from" the lime stabilization of spent pickle liquor (e.g., K062) is not a RCRA listed hazardous waste, if the sludge does not exhibit a hazardous waste characteristic (see discussion below on characteristic hazardous wastes). It should be noted, however, that wastes such as F003 and K062 *must* meet LDR treatment standards. Outside of the exceptions mentioned here and in the RCRA regulations, a hazardous waste that was generated via the "mixture rule" or the "derived from" rule must be delisted through a specific EPA petition process for the listed waste to be considered only a solid waste, and no longer managed as a listed hazardous waste under the RCRA Subtitle C system.

When applying the mixture rule to hazardous wastes, including mixed wastes, generators should be aware that EPA prohibits the dilution (i.e., mixing) of land disposal restricted waste or treatment residuals as a substitute for adequate treatment (see 40 CFR 268.3). An exception to the prohibition is the dilution of purely corrosive, and in some cases, reactive, or ignitable non-toxic wastes to eliminate the characteristic, or the aggregation of characteristic wastes in (pre)treatment systems regulated under the Clean Water Act (55 *FR* 22665).

(b) Characteristic Hazardous Wastes

Hazardous characteristics are based on the physical/chemical properties of wastes. Thus, physical/chemical testing of waste may be appropriate for determining whether a waste is a characteristic hazardous waste. *RCRA regulations, however, do not require testing. Rather, generators must determine whether the waste is a RCRA hazardous waste.* Such a determination may be made based on one's knowledge of the materials or chemical processes that were used. EPA's regulations are clear on this point. 40 CFR 262.11(c) states:

Facilities That Generate, Treat, Store, and Dispose of Hazardous Wastes" OSWER 9938.4-03, April 1994.

[7] The "mixture" and "derived-from" rules were vacated and remanded due to EPA's failure to provide adequate notice and opportunity for comment before their 1980 promulgation, in *Shell Oil* v. *EPA*, No. 80-1532 (D.C. Cir. Dec. 6, 1991). At the Court's suggestion, EPA reinstated the "mixture" and "derived-from" rules as interim final until the rules are revised through new EPA rulemaking. The "mixture" and "derived from" rules adopted by those States with authorized RCRA programs were not affected by the court case or the subsequent reinstatement by EPA. For further information, see 57 *FR* 49278, October 30, 1992, and 60 *FR* 66344, December 21, 1995.

". . . if the waste is not listed [as hazardous waste] in Subpart D [of 40 CFR Part 261], the generator must then determine whether the waste is identified in Subpart C of 40 CFR Part 261 by either:

(1) Testing the waste according to the methods set forth in Subpart C of 40 CFR Part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or

(2) Applying knowledge (emphasis added) of the hazardous characteristic of the waste in light of the materials or the processes used."

Therefore, where sufficient material or process knowledge exists, the generator need not test the waste to make a hazardous characteristic determination, although generators and subsequent handlers would be in violation of RCRA, if they managed hazardous waste erroneously classified as non-hazardous, outside of the RCRA hazardous waste system. For this reason, facilities wishing to minimize testing often assume a questionable waste is hazardous and handle it accordingly.

A generator must also comply with the land disposal restriction regulations in 40 CFR 268 which require the generator to determine whether the waste is prohibited from land disposal (refer to Section V for a detailed discussion of these requirements).[8] With respect to the hazardous characteristic, and the determination as to whether a waste is restricted from land disposal under 40 CFR 268.7(a), a generator may select the option of using waste knowledge. However, if the waste is determined to be land disposal restricted in 40 CFR 268.7(a), some testing will generally be required prior to land disposal, except where technologies are specified as the treatment standard. For mixed waste, EPA recommends that the frequency of such testing be held to a minimum, in order to avoid duplicative testing and repeated exposure to radiation.

In determining whether a radioactive waste is a RCRA hazardous waste, the generator may test a surrogate material (i.e., a chemically identical material with significantly less or no radioactivity) to determine the RCRA status of the radioactive waste. This substitution of a surrogate material may either partially or completely supplant the testing of the waste. A surrogate material, however, should only be used if the surrogate material faithfully represents the hazardous constituents of the mixed waste.[9] The following example discusses the use of surrogates. A generator is required to determine if a process waste stream containing lead (D008) exceeds the regulatory level of 5.0 milligrams per liter for the toxicity characteristic (40 CFR 261.24). If this determination cannot be made based on material and process knowledge only, the generator would need to test the hazardous material. Rather than testing the radioactive waste stream, the generator may opt to test a surrogate or chemically identical non-radioactive, or lower activity, radioactive waste stream generated by similar maintenance activities in another part of the plant. This substitution of materials is acceptable as long as the surrogate material faithfully represents the characteristics of the actual waste, and testing provides sufficient information for the generator to reasonably determine if the waste is hazardous under RCRA. Non-radioactive or lower activity quality control samples/species and spiked solutions, for instance, are acceptable to minimize exposure to radiation from duplicative mixed waste testing.

As part of the hazardous waste determination, a generator must document test results or other data and methods that it used. Specifically, 40 CFR 262.40(c) states that "a generator must keep records of any test results, waste analyses, or other determinations made in accordance with 40 CFR 262.11 for at least three years from the date that the waste was last sent to on-site or off-site treatment, storage, or disposal." Section V of this guidance contains information on record keeping requirements for land disposal restricted hazardous (and mixed) wastes.

In summary, testing listed wastes to make the hazardous waste determination is not necessary, because most RCRA hazardous waste codes or listings identify specific waste streams from specific processes or specific categories of wastes. Testing will most often occur to determine if a waste exhibits a hazardous characteristic. However, testing is not required if a generator has sufficient knowledge about the waste and its physical/chemical properties to determine that it is non-hazardous.[10] It is recognized that certain mixed waste streams, such as wastes from remediation activities or wastes produced many years ago, may have to be identified using laboratory analysis, because of a lack of waste or process information on these waste streams. Nonetheless, hazardous waste determinations based on generator knowledge can be used to reduce the sampling of mixed waste and prevent unnecessary exposure to radioactivity. The same principle holds for a generator's determination that a waste is subject to the RCRA land disposal restrictions in 40 CFR 268.7(a).

IV. Testing Protocols for Characteristics

When testing is conducted to determine whether a waste is a RCRA hazardous waste, there are acceptable test protocols or criteria for each of the four characteristics. Testing for characteristics must be done on a representative sample of the waste or using any applicable sampling methods specified in Appendix I of 40 CFR 261.[11]

Ignitability—For liquid wastes, other than aqueous solutions containing by volume less than 24 percent alcohol, the flash point is to be determined by a Pensky-Martens Closed Cup Tester, using the test method specified in American Society of Testing and Materials (ASTM) Standard D–93–79 or D–93–80, or a Setaflash Closed Cup Tester, using the test method specified in ASTM Standard D–3278–78, or as determined by an equivalent test method approved by the Administrator under procedures set forth in 40 CFR 260.20 and 260.21 (see "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," 3rd Ed., as amended, EPA, OSWER, SW–846, Methods 1010 and 1020[12]). (Non-liquid

[8] Generators who also treat their waste are subject to the requirements for treatment facilities unless they treat waste in accumulation tanks, containers, or containment buildings, for 90 days or less in accordance with 40 CFR 262.34(a). Treatment facilities must periodically test the treated waste residue from prohibited wastes to determine whether it meets the best demonstrated available technology (BDAT) treatment standards and may not rely on materials and process knowledge to make this determination (40 CFR 268.7(b)). This testing must be conducted according to the frequency specified in the facility's waste analysis plan (refer to Section IV of this guidance for a detailed discussion of treatment, storage, and disposal facility requirements).

[9] This definition of surrogate should not be confused with the definition of surrogate for the purposes of sampling and analysis quality control in Section 1.1.8 of "*Evaluating Solid Waste—Volume IA: Laboratory Test Methods Manual Physical/Chemical Methods.*"

[10] Note that characteristic only wastes (which are neither wastewater mixtures or RCRA listed hazardous wastes when generated) may be treated so that they no longer exhibit any of the four characteristics of a hazardous waste. However, these wastes may still be subject to the requirements of 40 CFR Part 268, even if they no longer exhibit a hazardous characteristic at the point of land disposal. After treatment this waste must not exhibit any RCRA hazardous waste characteristic *and* must meet applicable treatment standards before it can be considered a non-hazardous waste (see 57 *FR* 37263, August 18, 1992, and 58 *FR* 29869, May 24, 1993).

[11] Note that hazardous and mixed waste samples analyzed for waste characteristics or composition, and samples undergoing treatability studies may be exempt from all or part of the RCRA regulations if they are managed in accordance with 40 CFR 261.4 (d), (e) or (f).

[12] EPA incorporated by reference into the RCRA regulations (58 *FR* 46040, August 31, 1993), a third edition (and its updates) of "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods." The updates can be found in 60 *FR* 3089, January 13, 1995 (update II), 59 *FR* 458, January 4, 1994 (update IIA), 60 *FR* 17001, April 4, 1995

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wastes, compressed gases, and oxidizers may exhibit the characteristic of ignitability as described in 40 CFR 261.21 (a)(2–4).)

Corrosivity—For aqueous solutions, the pH is to be determined by a pH meter using either an EPA test method (i.e., SW–846, Method 9040 or an equivalent test method approved by the Administrator under procedures set forth in 40 CFR 260.20 and 260.21.) For liquids, steel corrosion is to be determined by the test method specified in National Association of Corrosion Engineers (NACE) Standard TM–01–69 as standardized in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," 3rd Ed., as amended (EPA, OSWER, SW–846, Method 1110), or an equivalent test method approved by the Administrator under procedures set forth in 40 CFR 260.20 and 260.21.

Reactivity—There are no specified test protocols for reactivity. 40 CFR 261.23 defines reactive wastes to include wastes that have any of the following properties: (1) normally unstable and readily undergoes violent change without detonating; (2) reacts violently with water; (3) forms potentially explosive mixtures with water; (4) generates dangerous quantities of toxic fumes, gases, or vapors when mixed with water; (5) in the case of cyanide- or sulfide-bearing wastes, generates dangerous quantities of toxic fumes, gases, or vapors when exposed to acidic or alkaline conditions; (6) explodes when subjected to a strong initiating force or if heated under confinement; (7) explodes at standard temperature and pressure; or (8) fits within the Department of Transportation's forbidden explosives, Class A explosives, or Class B explosives classifications.[13]

EPA has elected to rely on a descriptive definition for these reactivity properties because of inherent deficiencies associated with available methodologies for measuring such a varied class of effects, with the exception of the properties discussed in No. 5, above. The method used, as guidance but not required, to quantify the reactive cyanide and sulfide bearing wastes is provided in Chapter 7 of "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," 3rd Ed., as amended, EPA, OSWER, SW–846.

Toxicity Characteristic—The test method that may be used to determine whether a waste exhibits the toxicity characteristic (TC) is the Toxicity Characteristic Leaching Procedure (TCLP), as described in 40 CFR Part 261, Appendix II (SW–846, Method 1311). The TCLP was modified and revised in 55 *FR* 11798, March 29, 1990. Note that this revised TCLP is used (in most cases) for land disposal restriction compliance determinations as well. Differences between the TCLP and the previously required Extraction Procedure (EP) include improved analysis of the leaching of organic compounds, the elimination of constant pH adjustment, the addition of a milling or grinding requirement for solids (waste material solids must be milled to particles less than 9.5 mm in size), and other more detailed alterations.[14] Additionally, the TC rule added 25 organic compounds to the toxicity characteristic.

(update IIB), and 62 *FR* 32452, June 13, 1996 (update III). Hazardous and mixed waste generators and management facilities should verify that the analytical method that they use to analyze hazardous waste has not been superseded in the third edition.

[13] When evaluating test protocols for explosive mixed waste, consideration should be given to the likelihood for dispersing radioactivity during detonation. Using process knowledge or a surrogate material would, in most instances, be appropriate for these wastes.

The TCLP (Method 1311) recommends the use of a minimum sample size of 100 grams (solid and liquid phases as described in Section 7.2). *For mixed waste testing, sample sizes of less than 100 grams can be used, if the analyst can demonstrate that the test is still sufficiently sensitive to measure the constituents of interest at the regulatory levels specified in the TCLP and representative of the waste stream being tested.* Other variances to the published testing protocols are permissible (under 40 CFR 260.20–21), but must be approved prior to implementation by EPA. Use of a sample size of less than 100 grams is highly recommended for mixed wastes with concentrations of radionuclides that may present serious radiation exposure hazards.

Additionally, Section 1.2 of the TCLP allows the option of performing a "total constituent analysis" on a hazardous waste or mixed waste sample, instead of the TCLP. Section 1.2 of Method 1311 states:

> If a total analysis of the waste demonstrated that the individual analytes are not present in the waste, or that they are present, but at such low concentrations that the appropriate regulatory levels could not possibly be exceeded, the TCLP need not be run.

For homogenous samples, the use of total constituent analysis in this manner eliminates the need to grind or mill solid waste samples. The grinding or milling step in the TCLP has raised ALARA concerns for individuals who test mixed waste. The use of total constituent analysis, instead of the TCLP, may also minimize the generation of secondary mixed or radioactive waste through the use of smaller sample sizes and reduction, or elimination, of high dilution volume leaching procedures.

[14] Note that when using the TCLP, if any liquid fraction of the waste positively determines that hazardous constituents in the waste are above regulatory levels, then it is not necessary to analyze the remaining fractions of the waste. Extraction using the zero headspace extraction vessel (ZHE) is not required, furthermore, if the analysis of an extract obtained using a bottle extractor demonstrates that the concentration of a volatile compound exceeds the specified regulatory levels. The use of a bottle extractor, however, may not be used to demonstrate that the concentration of a volatile compound is below regulatory levels (40 CFR Part 261 Appendix II Sections 1.3 and .4).

Flexibility in Mixed Waste Testing

Flexibility exists in the hazardous waste regulations for generators, TSDFs, and mixed waste permit writers to tailor mixed waste sampling and analysis programs to address radiation hazards. For example, upon the request of a generator, a person preparing a RCRA permit for a TSDF has the flexibility to minimize the frequency of mixed waste testing by specifying a low testing frequency in a facility's waste analysis plan. EPA believes, as stated in 55 FR 22669, June 1, 1990, that "the frequency of testing is best determined on a case-by-case basis by the permit writer."

EPA's hazardous waste regulations also allow a mixed waste facility the latitude to change or replace EPA's test methods (i.e., *Test Methods for Evaluating Solid Waste* (SW–846)) to address radiation exposure concerns. There are only fourteen sections of the hazardous waste regulations that require the use of specific test methods or appropriate methods found in SW–846 which are outlined in Appendix A.[15] However, any person can request EPA for an equivalent testing or analytical method that would replace the required EPA method (see 40 CFR 260.21).

In a recent amendment to the testing requirements, EPA added language to SW–846 that describes fourteen citations in the RCRA program (listed in Appendix A) where the use of SW–846 methods is mandatory (Update II, 60 FR 3089, January 13, 1995). In all other cases, the RCRA program functions under what we call the Performance Based Measurement System (PBMS) approach to monitoring. Language clarifying this approach was included in the final FR Notice which promulgated Update III (62 FR 32542, June 13, 1997) and in appropriate sections (Disclaimer, Preface and Overview, and Chapter 2) of SW–846. Under PBMS, the regulation and/or permit focus is on the question(s) to be answered by the monitoring, the degree of confidence (otherwise known as the Data Quality Objective (DQO)) or the measurement quality objectives (MQO) that must be achieved by the permittee to have demonstrated compliance, and the specific data that must be gathered and documented by the permittee to demonstrate that the objectives were actually achieved. "Any reliable method" may be used to demonstrate that one can see the analytes of concern in the matrix of

[15] With the exception of the fourteen areas (see Appendix D) where test methods are required by hazardous waste regulation, use of EPA's *Test Methods for the Evaluation of Solid Waste* (SW–846) is not required, and should be viewed as guidance on acceptable sampling and analysis methods.

concern at the levels of concern. Additional reference documents on the characterization and testing methods are listed in Appendix C.

NRC regulations do not describe specific testing requirements for wastes to determine if a waste is radioactive. However, both NRC and Department of Transportation regulations contain requirements applicable to characterizing the radioactive content of the waste before shipment. For example, NRC's regulations in 10 CFR 20.2006 require that the waste manifest include, as completely as practicable, the radionuclide identity and quantity, and the total radioactivity. NRC regulations also require that generators determine the disposal Class of the radioactive waste, and outline waste form requirements that must be met before the waste is suitable for land disposal. These regulations are referenced in 10 CFR 20.2006, and are outlined in detail at 10 CFR 61.55 and 61.56. Mixed waste generators are reminded that both RCRA waste testing and NRC waste form requirements must be satisfied. Generators may also be required to amend their NRC or Agreement State licenses in order to perform the tests required under RCRA. In addition, if an NRC licensee uses an outside laboratory to test his or her waste, that laboratory may be required to possess an NRC or Agreement State license. It is the responsibility of the generator to determine if the outside laboratory possesses the proper license(s) prior to transferring the waste to the laboratory for testing.

Where radioactive wastes (or wastes suspected of being radioactive) are involved in testing, it has been suggested that the testing requirements of RCRA may run counter to the aims of the AEA. The AEA requirements that have raised inconsistency concerns with respect to RCRA testing procedures include ALARA, criticality, and security. Neither EPA nor NRC is aware of any specific instances where RCRA compliance has been inconsistent with the AEA. However, both agencies acknowledge the potential for an inconsistency to occur.[16] A licensee or applicant who suspects that an inconsistency may exist should contact both the AEA and RCRA regulatory agencies. These regulatory agencies may deliberate and consult on whether there is an unresolvable inconsistency and, if one exists, they may attempt to fashion the necessary relief from the particular RCRA provision that gives rise to the inconsistency. However, all other RCRA regulatory requirements would apply. That is, such a conclusion does not relieve hazardous waste facility owner/operators of the responsibility to ensure that the mixed waste is managed in accordance with all other applicable RCRA regulatory requirements. Owner/operators of mixed waste facilities are encouraged to address and document this potential situation and its resolution in the RCRA facility waste analysis plan which must be submitted with the Part B permit application, or addressed in a permit modification.

Both agencies also believe that the potential for inconsistencies can be reduced significantly by a better understanding of the RCRA requirements, a greater reliance on materials and process knowledge, the use of surrogate materials when possible, and the use of controlled atmosphere apparatuses for mixed waste testing. Where testing is conducted, the use of glove boxes and other controlled atmosphere apparatuses during the testing of the radioactive waste material lessens radiation exposure concerns significantly. These protective measures may also help to reconcile the required testing requirements (including milling) with concerns about maintaining exposures to radiation ALARA and complying with other AEA protective standards. If such protective measures do not exist, or do not adequately reduce individual exposure to radiation or address other factors of concern, relief may be available under Section 1006 of RCRA.

V. Determinations by Treatment, Storage, or Disposal Facility Owner/Operators and Certain Generators to Ensure Proper Waste MaNagement

General Waste Analysis

Owner/operators of facilities that treat, store, or dispose of hazardous wastes must obtain a chemical and physical analysis of a representative sample of the waste (see 40 CFR 264.13 for permitted facilities, or 40 CFR 265.13 for interim status facilities).[17] The purpose of this analysis is to assure that owner/operators have sufficient information on the properties of the waste to be able to treat, store, or dispose of the waste in a safe and appropriate manner.

The waste analysis may include data developed by the generator, and existing, published, or documented data on the hazardous waste or on hazardous waste generated from similar processes. In some instances, however, information supplied by the generator may not fully satisfy the waste analysis requirement. For example, in order to treat a particular waste, one may need to know not only the chemical composition of the waste, but also its compatibility with the techniques and chemical reagents used at the treatment facility. Where such information is not otherwise available, the owner/operator will be responsible for gathering relevant data on the waste in order to ensure its proper management.

The analysis must be repeated only if the previous analyses are inaccurate or needs updating. EPA regulations at 40 CFR 264.13(a)(3) do require that, at a minimum, a waste must be re-analyzed if:

(1) The owner/operator is notified, or has reason to believe, that the process or operation generating the waste has changed [in a way such that the hazardous property or characteristics of the waste would change]; and

(2) For off-site facilities, when the results of the verification analysis indicate that the [composition or characteristics of the] waste does not match the accompanying manifest or shipping paper.

The requirements and frequency of waste analysis for a given facility are described in the facility's waste analysis plan. As required by 40 CFR 264.13(b), the waste analysis plan must specify the parameters for which each hazardous waste will be analyzed; the rationale for selecting these parameters (i.e., how analysis for these parameters will provide sufficient information on the waste's properties); and the test methods that will be used to test for these parameters. The waste analysis plan also must specify the sampling method that will be used to obtain a representative sample of the waste to be analyzed; the frequency with which the initial analysis of the waste will be reviewed or repeated, to ensure that the analysis is accurate and up to date; and, for off-site facilities, the waste analyses to be supplied by the hazardous waste generators. Finally, the waste analysis plan must note any additional waste analysis requirements specific to the waste management method employed, such as the analysis of the waste feed to be burned in an incinerator.

The appropriate parameters for each waste analysis plan are determined on an individual basis as part of the permit

[16] An inconsistency occurs when compliance with one statute or set of regulations would necessarily cause non-compliance with the other. It may stem from a variety of considerations, including those related to occupational exposure, criticality, and other safeguards.

[17] A representative sample is defined in 40 CFR 260.10 as "a sample of a universe or whole (e.g., waste pile, lagoon, ground water) which can be expected to exhibit the average properties of the universe or whole." For further guidance see Chapter 9 of the EPA's testing guidance entitled *Test Methods for Evaluating Solid Waste* or SW-846.

application review process. To reduce the inherent hazards of sampling and analyzing radioactive material, and in particular, the potential risk to workers from exposure to radiation posed by duplicative testing of mixed wastes, redundant testing by the generator and off-site facilities should be avoided. In addition, waste analysis plans must include provisions to keep exposures to radiation ALARA, and incorporate relevant AEA-related requirements and regulations.

Analysis Required to Verify Off-site Shipments

The owner/operator of a facility that receives mixed waste from off-site must inspect and, *if necessary*, analyze each hazardous waste shipment received at the facility to verify that it matches the identity of the waste specified on the accompanying LDR notification or manifest (see 40 CFR 264.13 or 265.13(c)). This testing is known as verification testing. Such inspections and analysis will follow sampling and testing procedures set forth in the facility's waste analysis plan, which is kept at the facility.

It should also be emphasized that, where analysis is necessary, *RCRA regulations do not necessarily require the analysis of every movement of waste received at an off-site facility.* As explained above, the purpose of the waste analysis is to verify that the waste received at off-site facilities is correctly identified, and to provide enough information to ensure that it is properly managed by the facilities.

For example, if a facility receives a shipment of several sealed drums of mixed waste, a representative sample from only one drum may be adequate, if the owner/operator has reason to believe that the chemical composition of the waste is identical in every drum. In such a case, the drum containing the least amount of measurable radioactivity could be sampled to minimize radiation exposures (variations in radioactivity do not necessarily suggest different chemical composition). This procedure also would apply to a shipment of several types of waste. If the owner/operator has reason to believe that the drums in the shipment contain different wastes, then selecting a representative sample might involve drawing a sample from each drum or drawing a sample from one drum in each "set" of drums containing identical wastes. Once this waste analysis requirement has been satisfied, routine retesting of later shipments would not be required if the owner/operator can determine that the properties of the waste he or she manages will not change.

Fingerprint Analysis Versus Full Scale Analysis

Full scale analysis (i.e., detailed physical and chemical analysis) may be used to comply with the waste analysis plan, including verification of off-site shipments. However, for mixed waste, abbreviated analysis or "fingerprint analysis" may be more appropriate to meet general waste analysis requirements. The test procedure should be determined on a case-by-case basis.

Fingerprint analysis (which may involve monitoring pH, percent water, and cyanide content) is particularly recommended for mixed waste streams with high radiation levels that are received by an off-site TSDF for RCRA waste manifest verification purposes. It may be appropriate to use full scale analysis, instead of, or after, fingerprint analyses, if the facility suspects that the waste was not accurately characterized by the generator, information provided by a generator is incomplete, waste is received for the first time, or the generator changes a process or processes that produced the waste.

Generators Who Treat LDR Prohibited Waste In Tanks, Containers or Containment Buildings To Meet LDR Treatment Requirements

Hazardous waste generators may treat hazardous wastes in tanks or containers without obtaining a permit if the treatment is done in accordance with the accumulation timeframes and requirements in 40 CFR 262.34. However, generators who treat hazardous waste (including mixed wastes) to meet the EPA treatment standards for land disposal prohibited wastes must also prepare a waste analysis plan similar to that prepared by TSDFs. The plan must be based on a detailed analysis of a representative sample of the LDR prohibited waste that will be treated. In addition, the plan should include all the information that is necessary to treat the waste, including the testing frequency (See 40 CFR 268.7(a)(5)).

VI. Determinations Under the Land Disposal Restrictions

Generators, as well as treatment facilities and land disposal facilities, that handle mixed waste may have to obtain or amend their radioactive materials licenses if they test or treat mixed waste under the LDRs. The following discussion assumes that generators and treatment and disposal facilities have satisfied the requirement to obtain, or amend, their radioactive materials licenses, as appropriate.

Waste knowledge may also be used to satisfy certain waste characterization requirements imposed by the LDRs for mixed wastes. The Hazardous and Solid Waste Amendments (HSWA) to RCRA (P.L. 98–616), enacted on November 8, 1984, established the LDR program. This Congressionally mandated program set deadlines (RCRA Sections 3004(d)-(g)) for EPA to evaluate all hazardous wastes and required EPA to set levels, or methods, of treatment which would substantially diminish the toxicity of the waste, or minimize the likelihood of migration of hazardous constituents from any RCRA waste. Beyond specified dates, prohibited wastes that do not meet the treatment standards before they are disposed of, are banned from land disposal unless they are disposed of in a so-called "no-migration" unit (i.e., a unit where the EPA Administrator has granted a petition which successfully demonstrated to a reasonable degree of certainty that there will be no migration of hazardous constituents from the disposal unit for as long as the wastes remain hazardous)(40 CFR 268.6). Certain categories of prohibited wastes also may be granted extensions of the effective dates of the land disposal prohibitions (i.e., case-by-case and national capacity variances (40 CFR 268.5 and Subpart C, respectively). However, these wastes are still restricted and, if disposed in landfills or surface impoundments, must be disposed of in units meeting the minimum technology requirements.[18]

The requirements of the LDR program apply to generators, transporters, and owner/operators of hazardous waste treatment, storage, and disposal facilities. Not all hazardous wastes are subject to 40 CFR Part 268. For instance, certain wastes that are identified or listed after November 8, 1984, such as newly identified mineral processing wastes for which land disposal prohibitions or treatment standards have not yet been promulgated, are not regulated under 40 CFR Part 268.[19]

[18] A prohibited waste may not be land disposed unless it meets the treatment standards established by EPA. These standards are usually based on the performance of the BDAT. A waste that is subject to an extension, such as a national capacity variance, does not need to comply with the BDAT treatment standards, but is "restricted" and if it is going to be disposed in a landfill or surface impoundment, it can only be disposed of in a unit that meets the minimum technology requirements (MTRs). An exception exists for interim status surface impoundments which may continue receiving newly identified and restricted wastes for four years from the date of promulgation of the listings or characteristics before being retrofitted to meet the MTRs (RCRA Section 3005(j)(6)), so long as the only hazardous wastes in the impoundment are newly identified or listed.

[19] The treatment standards for mineral processing wastes and certain additional newly listed waste streams were proposed in 61 *FR* 2338, January 25,

Determinations by Generators

Under 40 CFR 268.7(a), generators must determine whether their waste is restricted from land disposal (or determine if they are subject to an exemption or variance from land disposal (40 CFR 268.1)) by testing their waste (or a leachate of the waste developed using the TCLP or, in certain cases, the Extraction Procedure Toxicity Test (EP), or by using waste or process knowledge). If the waste exhibits the characteristic of ignitability (and is not in the High Total Organic Constituents (TOC) Ignitable Liquids Subcategory or is not treated by the "CMBST" or "RORGS" treatment technology in 40 CFR 268.42, Table 1), corrosivity, reactivity and/or organic toxicity, the generator must also determine the underlying hazardous constituents (UHCs) in the waste. Two exceptions to this requirement are: (1) if these wastes are treated in wastewater treatment systems subject to the Clean Water Act (CWA) or CWA equivalent; or, (2) if they are injected into a Class I, non-hazardous Underground Injection Control well. A UHC is any constituent listed in 40 CFR 268.48, Table UTS-Universal Treatment Standards, with the exceptions of nickel, zinc and vanadium, which can reasonably be expected to be present at the point of generation of the hazardous waste, at a concentration above the constituent-specific UTS treatment standard. Determining the presence of the UHCs may be made based on testing or knowledge of the waste. The UHCs must meet the UTS before the waste may be land disposed.

If a generator chooses to test the waste rather than use waste or process knowledge for hazardous waste that is not listed and exhibits a characteristic only, the generator must use the TCLP. The only exception is TC metals.

Until the "Phase IV" LDR rule is promulgated in the spring of 1998, generators who characterize their wastes as TC toxic only for metals may use the EP instead of the TCLP result to determine if their waste is land disposal restricted, because the TC wastes do not have final EPA treatment standards whereas, at this time, the EP metals do. If the EP result is negative, the waste will still be considered hazardous, but is not prohibited from land disposal. The TCLP generally yields similar results as the EP. However, in certain matrices the TCLP yields higher lead and arsenic concentrations than the EP. The rationale for using the EP instead of the TCLP for characteristic wastes is explained in 55 FR 3865, January 31, 1991. For further guidance on using the EP for the land disposal restriction determination, refer to the Figures 1 and 2, of this guidance.

If a waste is found to be land disposal restricted, generators must determine if the waste can be land disposed without further treatment. A prohibited waste may be land disposed if it meets applicable treatment standards (whether through treatment or simply as generated), or is subject to a variance from the applicable standards. As explained above, this determination can be made either based on knowledge of the waste or by testing the waste, or waste leachate using the TCLP.

Generators who determine that their listed waste meets the applicable treatment standards must certify to this determination and notify the treatment, storage, or land disposal facility that receives the waste (40 CFR 268.7(a)(3)). Notification to the receiving facility must be made with the initial shipment of waste and must include the following information:

- EPA Hazardous Waste Number;
- Certification that the waste delivered to a disposal facility meets the treatment standard, and that the information included in the notice is true, accurate, and complete;
- Waste constituents that will be monitored for compliance if monitoring will not include all regulated constituents, for wastes F001-F005, F039, D001, D002, and D012-D043;
- Whether the waste is a non-wastewater or wastewater;
- The subcategory of the waste (e.g., "D003 reactive cyanide"), if applicable;
- Manifest number; and,
- Waste analysis data (if available).

If a generator determines that a waste that previously exhibited a characteristic is no longer hazardous, or is subject to an exclusion from the definition of hazardous waste, a one-time notification and certification must be place in the generator's files (40 CFR 268.7(a)(7) or 268.9).

Generators who determine that their waste does not meet the applicable treatment standards must ensure that this waste meets the applicable standards prior to disposal. These generators may treat (or store) their prohibited wastes on-site for 90 days or less in qualified tanks, containers (40 CFR 262.34), or containment buildings (40 CFR 268.50), and/or send their wastes off-site for treatment.[20] When prohibited listed wastes are sent off-site, generators must notify the treatment facility of the appropriate treatment standards (40 CFR 268.7(a)(2)). This notification must be made with the initial shipment of waste and must include the following information:

- EPA Hazardous Waste Number;
- Waste constituents that the treater will monitor if monitoring will not include all regulated constituents, for wastes F001–F005, F039, D001, D002, and D012–D043;
- Whether the waste is a non-wastewater or wastewater;
- The subcategory of the waste (e.g., "D003 reactive cyanide"), if applicable;
- Manifest number; and,
- Specified information for hazardous debris.

Generators whose wastes are subject to an exemption such as a case-by-case extension under 40 CFR 268.5, an exemption under 40 CFR 268.6 (a no-migration variance), or a nationwide capacity variance under 40 CFR 268, Subpart C must also notify the land disposal facility of the exemption. In addition, records of all notices, certifications, demonstrations, waste analysis data, process knowledge determinations, and other documentation produced pursuant to 40 CFR Part 268 must be maintained by the generator for at least three years from the date when the initial waste shipment was sent to on-site or off-site treatment, storage, or disposal (40 CFR 268.7(a)(8)).

Determinations by Treaters and Disposers

Owner/operators of treatment facilities that receive wastes that do not meet the treatment standards are responsible for treating the wastes to the applicable treatment standards or by the specified technology(ies). In addition, the owner/operators of treatment facilities must determine whether the wastes meet the applicable treatment standards or prohibition levels by testing:

(1) The treatment residues, or an extract of such residues using the TCLP, for wastes with treatment standards expressed as concentrations in the waste extract (40 CFR 268.40); and.

(2) The treated residues (not an extract of the treated residues) for wastes with

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1996, and a second supplemental proposed rule signed April 18, 1997.

[20] Non-wastewater residues (e.g., slag) that result from high temperature metals recovery that are excluded from the definition of hazardous waste by meeting the conditions of 40 CFR 261.3(c)(2)(ii)(C), and hazardous debris that is excluded from the definition of hazardous waste in 40 CFR 261.3(f) have reduced LDR notification requirements. Specifically, these wastes, and characteristic hazardous wastes that are rendered non-hazardous, do not require a notification and certification accompanying each shipment. Instead, they may be sent to an AEA-licensed facility with a one-time notification and certification sent to the EPA Region or authorized State.

treatment standards expressed as concentrations in the waste extract (40 CFR 268.40).

This testing should be done at the frequency established in the facility's waste analysis plan. Owner/operators of treatment facilities, however, do not need to test the treated residues or an extract of the residues if the treatment standard is a specified-technology (i.e., a technology specified in 40 CFR 268.40 or 268.45, Table 1.—Alternative Treatment Standards for Hazardous Debris).

Owner/operators of land disposal facilities under the LDRs are responsible for ensuring that only waste meeting the treatment standards (i.e., wastes not prohibited from disposal or wastes that are subject to an exemption or variance) is land disposed. Like a treatment facility, a disposal facility must test a treatment residue or an extract of the treatment residue, except where the treatment standard is a specified technology.

Owner/operators must periodically test wastes received at the facility for disposal (i.e., independent corroborative testing) as specified in the waste analysis plan to ensure the treatment has been successful and the waste meets EPA treatment standards, except where the treatment standard is expressed as a technology.[21] The results of any waste analyses are placed in a TSDF's operating records along with a copy of all certifications and notices (40 CFR 264.73 or 40 CFR 265.73).[22]

Mixed Waste Under the LDRs

As clarified in the Land Disposal Restrictions rule published on June 1, 1990 (see EPA's "Third Third rule," 55 FR 22669, June 1, 1990), the frequency of testing, such as corroborative testing for treatment and disposal facilities, should be determined on a case-by-case basis and specified in the RCRA permit. This flexibility is necessary because of the variability of waste types that may be encountered. Mixed waste is unique for its radioactive/hazardous composition and dual management requirements. Each sampling or analytical event involving mixed waste may result in an incremental exposure to radiation, and EPA's responsibility to protect human health and the environment must show due regard for minimizing this unique risk. These are factors which should be considered in implementing the flexible approach to determining testing frequency spelled out in the Third Third Rule language. This flexible approach encourages reduction in testing where there is little or no variation in the process that generates the waste, or in the treatment process that treats the waste, and an initial analysis of the waste is available. Also, the approach may apply to mixed wastes shipped to off-site facilities, where redundant testing is minimized by placing greater reliance on the characterization developed and certified by earlier generators and treatment facilities. On the other hand, where waste composition is not well-known, testing frequency may be increased. Waste analysis plan conditions in the permits of mixed waste facilities should reflect these principles.

Revised Treatment Standards for Solvent Wastes

EPA promulgated revised treatment standards for wastewater and non-wastewater spent solvent wastes (F001–F005) in 57 FR 37194, August 18, 1992. The revision essentially converts the treatment standards for the organic spent solvent waste constituents (F001–F005) from TCLP based to total waste constituent concentration based. This conversion of the spent solvent treatment standards is particularly advantageous to mixed waste generators, since the entire waste stream or treatment residual must be analyzed (instead of a waste or treatment residual extract). This holds true for other mixed waste streams where the hazardous component is measured using a total waste analysis. As discussed in Section IV of this guidance, total constituent analysis has several advantages over the use of the TCLP for high activity waste streams.

EPA and NRC are aware of potential hazards attributable to testing hazardous waste. Moreover, EPA and NRC recognize that the radioactive component of mixed waste may pose additional hazards to laboratory personnel, inspectors, and others who may be exposed during sampling and analysis. All sampling should be conducted in accordance with procedures that minimize exposure to radiation and ensure personnel safety. Further, testing should be conducted in laboratories licensed by NRC or the appropriate NRC Agreement State authority. EPA and NRC believe that a combination of common sense, modified sampling procedures, and cooperation between State and Federal regulatory agencies will minimize any hazards associated with sampling and testing mixed waste.

Note: Section V, "Determinations under the Land Disposal Restrictions (LDRs)" and the following flow charts represent a brief summary of the Land Disposal Restriction Regulations. They are not meant to be a complete or detailed description of all applicable LDR regulations. For more information concerning the specific requirements, consult the **Federal Registers** cited in the document and the Code of Federal Regulations, Title 40 Parts 124, and 260 through 271.

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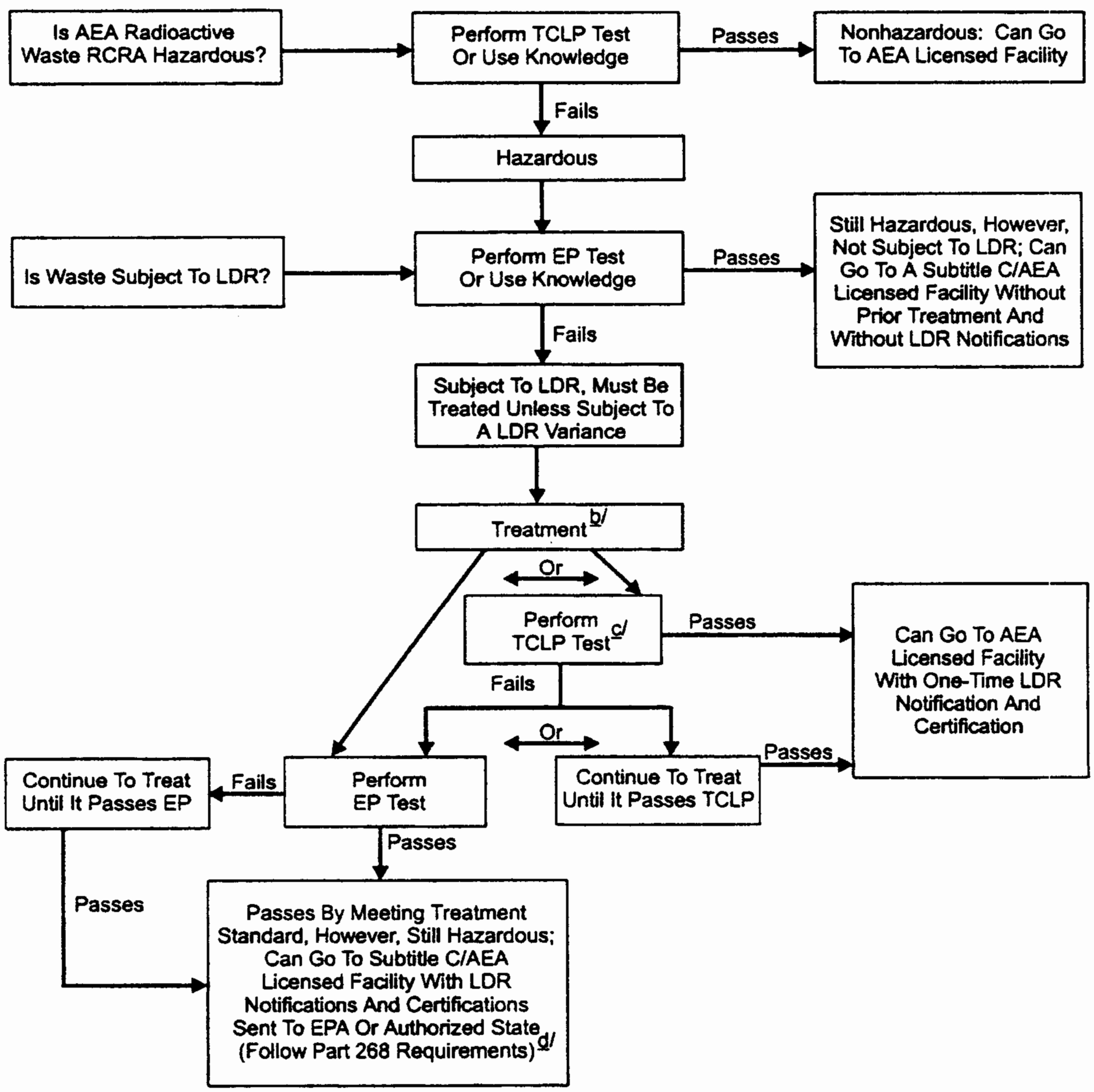
[21] Note that verification testing is a means to verify that the wastes received match the waste description on the manifest, which is required under 40 CFR 264.13 and 40 CFR 265.13(c). The main objective of corroborative testing is to provide an independent verification that a waste meets the LDR treatment standard.

[22] Land disposal facilities must maintain a copy of all LDR notices and certifications transmitted from generators and treaters (40 CFR 268.7(c)).

FIGURE ONE: TESTING REQUIREMENTS FOR CHARACTERISTIC LEAD AND ARSENIC NONWASTEWATERS ONLY[a/]



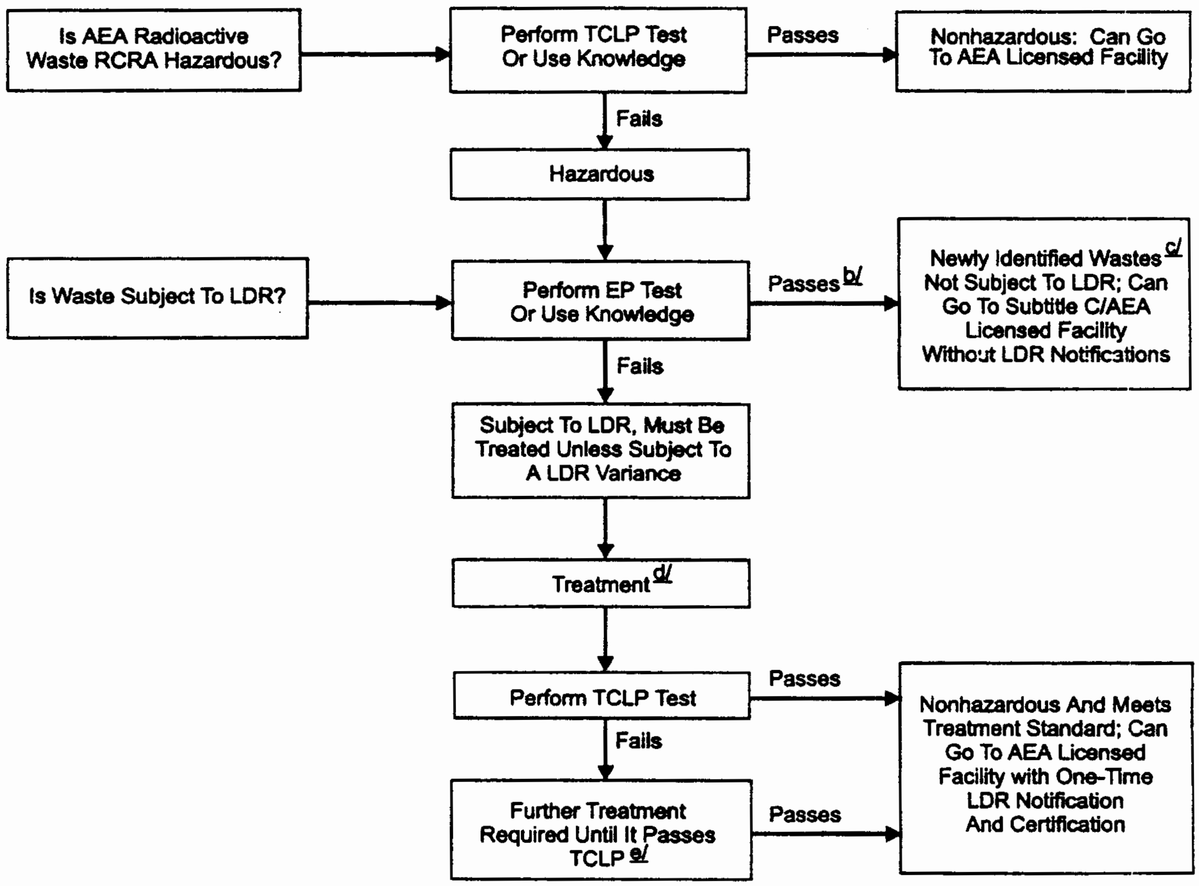
a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

b/ If the treatment standard is expressed as a specified technology, no further testing is required. However, the mixed waste must go to a Subtitle C/AEA licensed facility with LDR notifications and certifications.

c/ TCLP generally yields higher concentrations than EP for lead and arsenic in certain matrices.

d/ If the waste meets the treatment standard and passes the TCLP, it can go to an AEA licensed facility with one-time LDR notification and certification.

FIGURE TWO: TESTING REQUIREMENTS FOR ALL OTHER CHARACTERISTIC METALS[a/]



a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

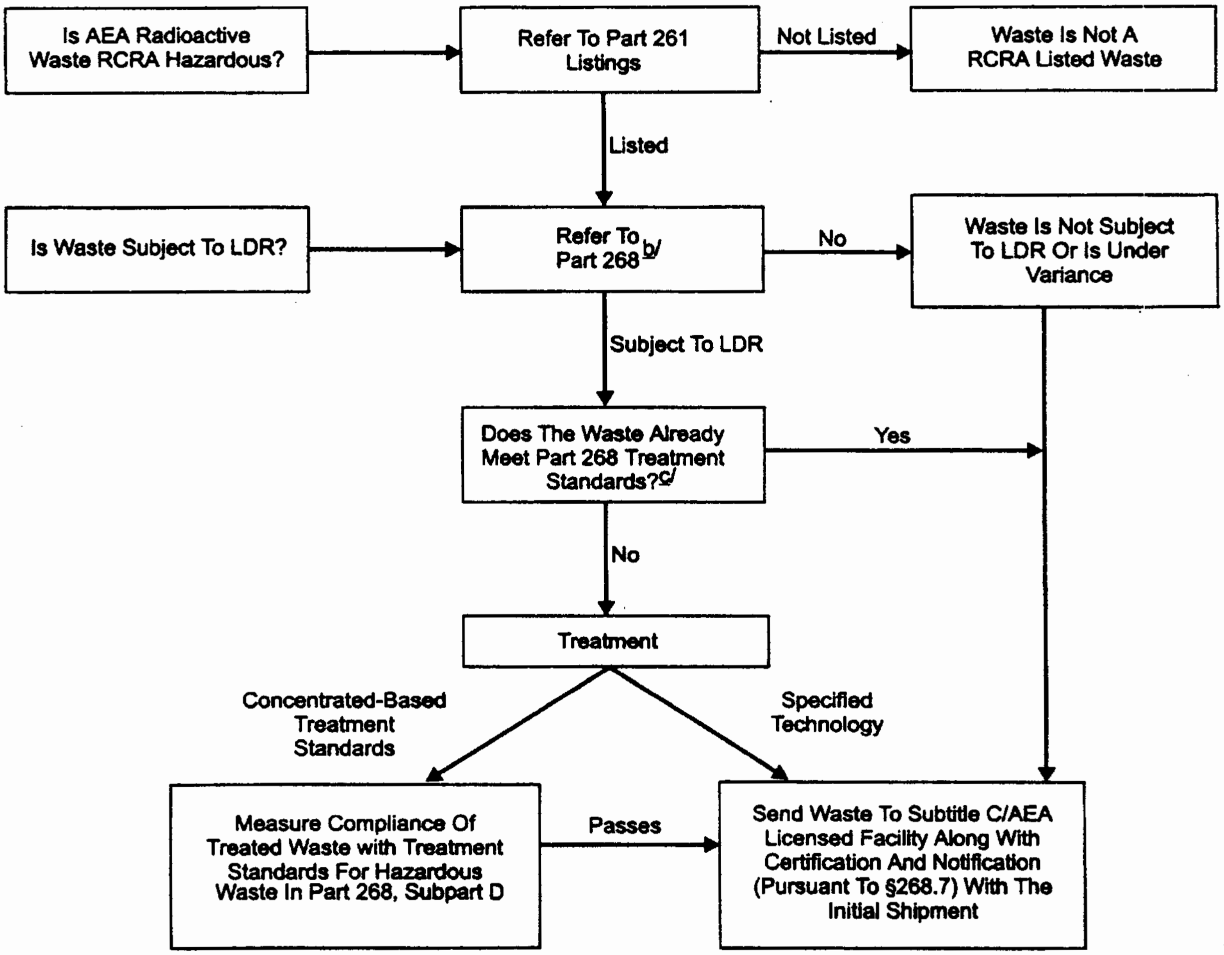
b/ This should be rare, since the two tests usually yield similar results.

c/ Wastes exhibiting the toxicity characteristic but not the EP are newly identified wastes and, therefore, are not subject to the land disposal restrictions at this time.

d/ If the treatment standard is expressed as a specified technology, no further testing is required. However, the mixed waste must go to a Subtitle C/AEA licensed facility with LDR notifications and certifications.

e/ Selenium is the one exception because it has a treatment standard slightly above the characteristic level.

FIGURE THREE: TESTING REQUIREMENTS FOR RCRA LISTED HAZARDOUS WASTES ONLY[a/]

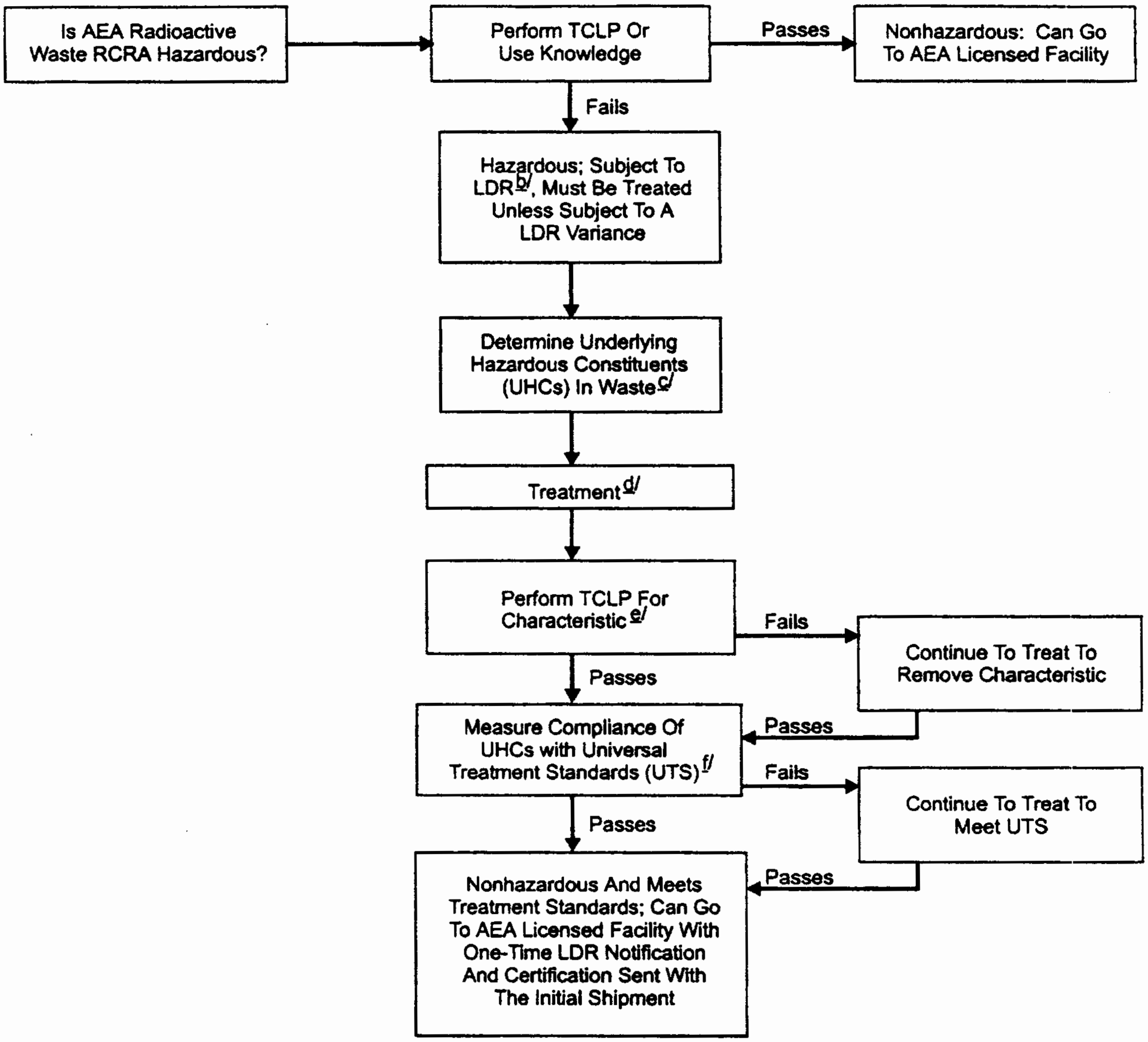


a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

b/ Refer to §268.1 to determine if LDR is applicable to waste. If so, test using TCLP or use process knowledge to determine if waste is restricted (§268.7).

c/ Test using TCLP or use process knowledge.

FIGURE FOUR: ORGANIC TOXICITY CHARACTERISTIC (TC) WASTES AND PESTICIDE WASTES[a/]



a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

b/ Restriction applies to TC organic and pesticide wastes managed in non-CWA/non-CWA equivalent/ non-Class I SDWA systems only.

c/ Testing or knowledge of waste may be used. A UHC is any constituent listed in§268.48 Table UTS, except zinc, that can reasonable be expected to be present at the point of generation of the hazardous waste, at a concentration above the constituent-specific UTS treatment standard.

d/ If the treatment standard is expressed as a specified technology, no further testing is required. However, the mixed waste must go to a Subtitle C/AEA facility with LDR notifications and certifications.

e/ Refer to the table "Treatment Standards for Hazardous Wastes" in 40 CFR Part 268, Subpart D.

f/ Compliance should be measured based on the appropriate testing protocols (see SW-846).

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Appendix A—RCRA Regulations That Require Specific EPA Test Methods

The use of an SW–846 method is mandatory for the following nine Resource Conservation and Recovery Act (RCRA) applications contained in 40 CFR Parts 260 through 270:

- Section 260.22(d)(1)(I)—Submission of data in support of petitions to exclude a waste produced at a particular facility (i.e., delisting petitions);
- Section 261.22(a)(1) and (2)—Evaluations of waste against the corrosivity characteristic;
- Section 261.24(a)—Leaching procedure for evaluation of waste against the toxicity characteristic;
- Section 261.35(b)(2)(iii)(A)—Evaluation of rinsates from wood preserving cleaning processes;
- Sections 264.190(a), 264.314(c), 265.190(a), and 265.314(d)—Evaluation of waste to determine if free liquid is a component of the waste;
- Sections 264.1034(d)(1)(iii) and 265.1034(d)(1)(iii)—Evaluation of organic emissions from process vents;
- Sections 264.1063(d)(2) and 265.1063(d)(2)—Evaluation of organic emissions from equipment leaks;
- Section 266.106(a)—Evaluation of metals from boilers and furnaces;
- Sections 266.112(b)(1) and (2)(I)—Certain analyses in support of exclusion from the definition of a hazardous waste for a residue which was derived from burning hazardous waste in boilers and industrial furnaces;
- Sections 268.7(a), 268.40(a), (b), and (f), 268.41(a), 268.43(a)—Leaching procedure for evaluation of waste to determine compliance with land disposal treatment standards;
- Sections § 270.19(c)(1)(iii) and (iv), and 270.62(b)(2)(I)(C) and (D)—Analysis and approximate quantification of the hazardous constituents identified in the waste prior to conducting a trial burn in support of an application for a hazardous waste incineration permit; and
- Sections 270.22(a)(2)(ii)(B) and 270.66(c)(2)(I) and (ii)—Analysis conducted in support of a destruction and removal efficiency (DRE) trial burn waiver for boilers and industrial furnaces burning low risk wastes, and analysis and approximate quantification conducted for a trial burn in support of an application for a permit to burn hazardous waste in a boiler and industrial furnace.

APPENDIX B.—STATES AND TERRITORIES WITH MIXED WASTE AUTHORIZATION

[As of June 30, 1997]

State/territory	FR date	Effective date	FR cite
Colorado	10/24/86	11/7/86	51 FR 37729.
Tennessee	6/12/87	8/11/87	52 FR 22443.
S. Carolina	7/15/87	9/13/87	52 FR 26476.
Washington	9/22/87	11/23/87	52 FR 35556
Georgia	7/28/88	9/26/88	53 FR 28383.
Nebraska	10/4/88	12/3/88	53 FR 38950.
Kentucky	10/20/88	12/19/88	53 FR 41164.
Utah	2/21/89	3/7/89	54 FR 7417.
Minnesota	4/24/89	6/23/89	54 FR 16361.
Ohio	6/28/89	6/30/89	54 FR 27170.
Guam	8/11/89	10/10/89	54 FR 32973.
N. Carolina	9/22/89	11/21/89	54 FR 38993.
Michigan	11/24/89	12/26/89	54 FR 48608.
Texas	3/1/90	3/15/90	55 FR 7318.
New York	3/6/90	5/7/90	55 FR 7896.
Idaho	3/26/90	4/9/90	55 FR 11015.
Illinois	3/1/90	4/30/90	55 FR 7320.
Arkansas	3/27/90	5/29/90	55 FR 11192.
Oregon	3/30/90	5/29/90	55 FR 11909.
Kansas	4/24/90	6/25/90	55 FR 17273.
N. Dakota	6/25/90	8/24/90	55 FR 25836.
New Mexico	7/11/90	7/25/90	55 FR 28397.
Oklahoma	9/26/90	11/27/90	55 FR 39274.
Connecticut	12/17/90	12/31/90	55 FR 51707.
Florida	12/14/90	2/12/91	55 FR 51416.
Mississippi	3/29/91	5/28/91	56 FR 13079.
S. Dakota	4/17/91	6/17/91	56 FR 15503.
Indiana	7/30/91	9/30/91	56 FR 41959.
Louisiana	8/26/91	10/26/91	56 FR 41959.
Wisconsin	4/24/92	4/24/92	57 FR 15092.
Nevada	4/29/92	6/29/92	57 FR 18083.
California	7/23/92	8/1/92	57 FR 32725.
Arizona	11/23/92	1/22/93	57 FR 54932.
Missouri	1/11/93	3/12/93	58 FR 3497.
Alabama	3/17/93	5/17/93	58 FR 14319.
Vermont	6/7/93	8/6/93	58 FR 31911.
Montana	1/19/94	3/21/94	59 FR 2752.
New Hampshire	11/14/94	1/13/95	59 FR 56397.
Wyoming	10/04/95	10/18/95	60 FR 51925.
Delaware	8/8/96	10/7/96	61 FR 41345.
Total: 39 States and 1 Territory.			

Appendix C: Testing Reference Documents

The following references provide information on approved methods for testing hazardous waste samples:

American Public Health Association, *Standard Methods for the Examination of Water and Wastewater, 17th Edition.* 1989. Available from the Water Pollution Control Federation, Washington, D.C., #S0037.

U.S. Environmental Protection Agency, *Design and Development of a Hazardous Waste Reactivity Testing Protocol.* EPA Document No. 600/2-84-057, February 1984.

U.S. Environmental Protection Agency, *Methods for Chemical Analysis of Water and Waste.* EPA-6001114-79-020. Washington, D.C., 1983.

U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* SW-846. Third Edition (1986) as amended. Avail able from the Government Printing Office, by subscription, 955-001-00000-1, or from the National Technical Information Service, PB88-239-223. Washington, D.C., January, 1995.

U.S. Environmental Protection Agency, *The New Toxicity Characteristic Rule: Information and Tips for Generators.* Office of Solid Waste, 530/SW-90-028, April, 1990.

U.S. Environmental Protection Agency, ORD, and U.S. Department of Energy, *Characterizing Heterogenous Wastes: Methods and Recommendations.* EPA/600/R-92/033, February 1992.

U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. "Joint EPA/NRC Guidance on the Definition and Identification of Commercial Mixed Low-Level Radioactive and Hazardous Waste," Directive No. 9432-00-2, October 4, 1989.

Appendix D: List of Regulations

Environmental Protection Agency General Regulations for Hazardous Waste Management, 40 CFR Part 260.

Environmental Protection Agency Regulations for Identifying Hazardous Waste, 40 CFR Part 261.

Environmental Protection Agency Regulations for Hazardous Waste Generators, 40 CFR Part 262.

Environmental Protection Agency Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, 40 CFR Part 264.

Environmental Protection Agency Interim Status Standards for Owners and Operators of Hazardous Waste Facilities, 40 CFR Part 265.

Environmental Protection Agency Regulations on Land Disposal Restrictions, 40 CFR Part 268.

Nuclear Regulatory Commission Regulations—Standards for Protection Against Radiation, 10 CFR Part 20.

Nuclear Regulatory Commission Regulations—Rules of General Applicability to Domestic Licensing of Byproduct Material, 10 CFR Part 30.

Nuclear Regulatory Commission Regulations—Domestic Licensing of Source Material, 10 CFR Part 40.

Nuclear Regulatory Commission Regulations—Domestic Licensing of Production and Utilization Facilities, 10 CFR Part 50.

Nuclear Regulatory Commission Regulations—Licensing Requirements for Land Disposal of Radioactive Waste, 10 CFR Part 61.

Nuclear Regulatory Commission Regulations—Domestic Licensing of Special Nuclear Material, 10 CFR Part 70.

[FR Doc. 97-30528 Filed 11-19-97; 8:45 am]

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PRESIDENT'S COMMISSION ON CRITICAL INFRASTRUCTURE PROTECTION TRANSITION OFFICE

Advisory Committee for the President's Commission on Critical Infrastructure Protection; Meeting

Time & Date: 9:00 a.m.–6:00 p.m., Wednesday, December 3, 1997.

Action: Notice of Meeting.

Summary: Pursuant to the provisions of the Federal Advisory Committee Act (Pub.L. 92-463, 86 Stat. 770), notice is hereby given for the second meeting of the Advisory Committee on the President's Commission on Critical Infrastructure Protection.

Address: The Madison Hotel, 15th and M St., NW, Washington, D.C. 20005. Public seating is limited and is available on a first-come, first-served basis. This facility is accessible to persons with disabilities.

For Further Information Contact: Carla Sims, Public Affairs Officer, (703) 696-9395, comments@pccip.gov. Hearing-impaired individuals are advised to contact the Virginia Relay Center (Text Telephone (800) 828-1120 or Voice (800) 828-1140), or their local relay system.

Supplementary Information: The Advisory Committee was established by the President to provide expert advice to the Commission as it developed a comprehensive national policy and implementation strategy for protecting the nation's critical infrastructures. The Committee is co-chaired by the Honorable Jamie Gorelick, Vice Chair of Fannie Mae, and the Honorable Sam Nunn, Partner with the law firm of King & Spaulding. The Committee currently consists of 14 members representing various industry sectors.

Purpose of the Meeting: This is the second advisory meeting of the Committee. The Committee will review and discuss the recommendations contained in the Commission's report to the President, "Critical Foundations: Protecting America's Infrastructure's."

Tentative Agenda: The Advisory Committee meeting will review and discuss the recommendations contained in the Commission's report. The unclassified report is available electronically from the Commission's site on the World Wide Web (http://www.pccip.gov/).

Public Participation: The morning session of the meeting will be open to the public. Written comments may be filed with the Commission after the meeting. Written comments may be given to the Designated Federal Officer after the conclusion of the open meeting; mailed to the Commission at P.O. Box 46258, Washington, D.C. 20050-6258; or emailed to comments@pccip.gov/.

Closed Meeting Deliberations: In accordance with Section 10(d) of the Federal Advisory Committee Act, Pub. L. 92-463 [5 U.S.C. App II, (1982)], it has been determined that the afternoon session concerns matters listed in 5 U.S.C. 552b (c)(1)(1982). Therefore, the afternoon meeting will be closed to the public in order for the committee to discuss classified material.

Robert E. Giovagnoni,

General Counsel, President's Commission on Critical Infrastructure Protection Transition Office.

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BILLING CODE 3110-$$-P

OFFICE OF THE UNITED STATES TRADE REPRESENTATIVE

Notice of Meeting of the Advisory Committee for Trade Policy and Negotiations

AGENCY: Office of the United States Trade Representative.

ACTION: Notice that the December 4, 1997, meeting of the Advisory Committee for Trade Policy and Negotiations will be held from 10:00 a.m. to 2:00 p.m. The meeting will be closed to the public from 10:00 a.m. to 1:30 p.m. and open to the public from 1:30 p.m. to 2:00 p.m.

SUMMARY: The Advisory Committee for Trade Policy and Negotiation will hold a meeting on December 4, 1997 from 10:00 a.m. to 2:00 p.m. The meeting will be closed to the public from 10:00 a.m. to 1:30 p.m. The meeting will include a review and discussion of current issues which influence U.S. trade policy. Pursuant to Section 2155(f)(2) of Title 19 of the United States Code, I have determined that this meeting will be concerned with matters the disclosure of which would seriously compromise the development by the United States Government of trade policy, priorities, negotiating objectives or bargaining positions with respect to the operation of any trade agreement and other matters arising in connection with the development, implementation and administration of the trade policy of the United States. The meeting will be open

United States
Environmental Protection
Agency

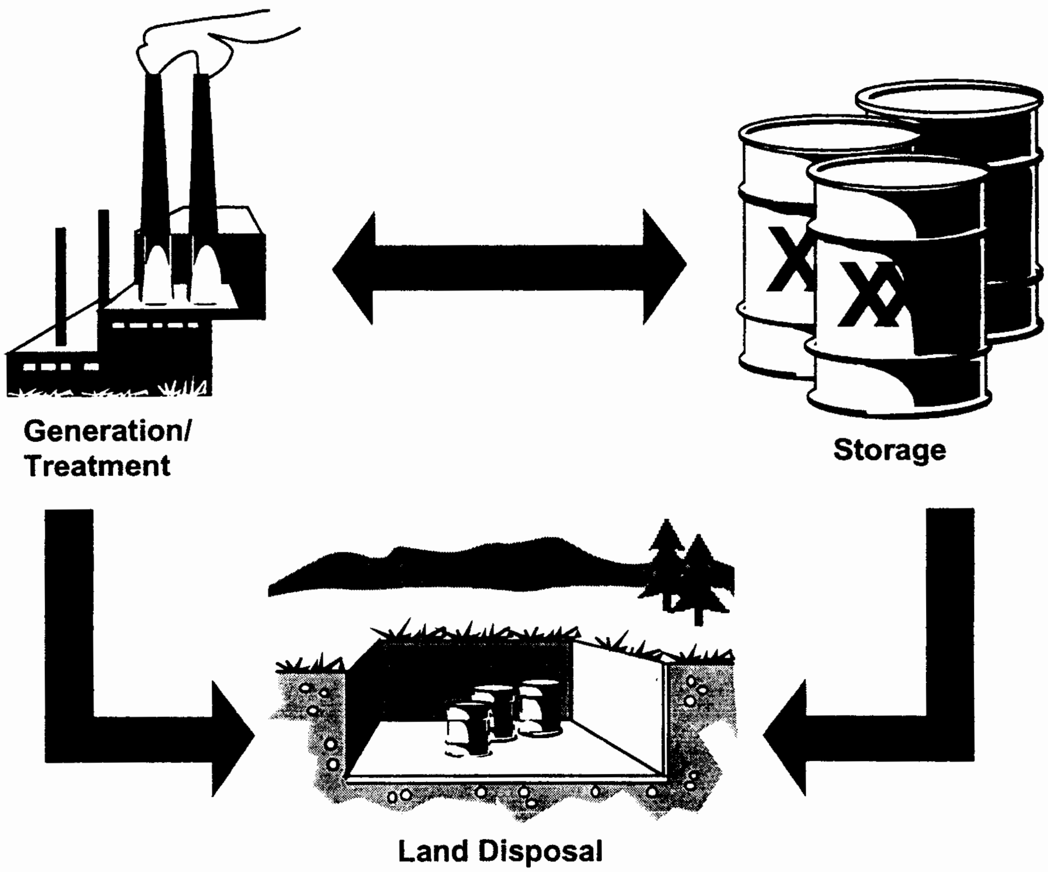
Solid Waste And
Emergency Response
(OS-520)

OSWER 9938.4-03
April 1994

EPA

Waste Analysis At Facilities That Generate, Treat, Store, And Dispose Of Hazardous Wastes

A Guidance Manual



When Might Full-Scale Analysis Be Used?

Therefore, to ensure compliance with RCRA you should conduct a full-scale, or under certain circumstances an abbreviated-scale, sampling, and laboratory testing program for all wastes prior to managing the wastes. **Full-scale analysis** (e.g., EPA's SW-846 methods or equivalent) may be necessary when:

- A generator begins a new process or changes an existing process
- Wastes are received by a facility for the first time
- A generator has not provided appropriate laboratory information to an off-site TSDF
- An off-site TSDF has reason to suspect that the wastes shipped were not accurately identified by the generator
- EPA changes RCRA waste identification/classification rules.

When Might Fingerprint Analysis Be Used?

Abbreviated waste analysis, often referred to as **"fingerprint analysis,"** is conducted generally for parameters (e.g., specific gravity, color, flash point, presence of more than one phase, pH, halogen content, cyanide content, percent water) that will give information that can be used to help verify that the waste generated, or received by an off-site TSDF, matches the expected characteristics for that waste. For example, at an off-site TSDF, fingerprint analysis can be used to indicate that the waste received matches the description on the manifest, and that the waste matches the waste type that the facility has agreed to accept. Because the owner/operator of a TSDF already knows the detailed chemical and physical properties of a waste, the appropriate fingerprint or spot check parameters can be chosen easily, since the purpose of the fingerprint or spot check is only to verify that each waste arriving at the gate of the TSDF is the actual waste expected. The number and character of fingerprint parameters and the criteria for acceptance/rejection of the waste will be discussed in Part Two of this manual.

1.5.2 Option Two: Selecting Acceptable Knowledge

When Might Acceptable Knowledge Be Used?

Generators and TSDFs may use acceptable knowledge alone or in conjunction with sampling and laboratory analysis. As previously stated, an off-site TSDF is not relieved of its responsibility to obtain accurate waste analysis data despite the submission of erroneous information provided to the TSDF by the generator. As discussed briefly on the previous page, however, there are situa

tions where it may be appropriate to apply acceptable knowledge, including:

- Hazardous constituents in wastes from specific processes are well documented, such as with the F-listed and K-listed wastes.

- Wastes are discarded unused commercial chemical products, reagents or chemicals of known physical, and chemical constituents. Several of these fall into the P-listed and U-listed categories (40 CFR §261.33).

- Health and safety risks to personnel would not justify sampling and analysis (e.g., radioactive mixed waste).

- Physical nature of the waste does not lend itself to taking a laboratory sample. For example, to conduct waste analysis of surface-contaminated construction debris, such as steel girders, piping, and linoleum, it may be necessary to use a combination of laboratory analysis and process knowledge. The process knowledge would be applied to identifying the composition of the base construction materials (e.g., steel). One could then collect surface "wipe" samples and conduct laboratory analysis to determine the representative concentrations of any contaminants present. If the base materials are porous, such as gypsum, the contamination could be determined by conducting analysis on the extracts obtained from a solvent wash.

Acceptable knowledge is not an appropriate substitute for fingerprint or spot check procedures except in the unique case when the TSDF is accepting properly manifested waste from another site owned by the same company.

Why Document Acceptable Knowledge?

If you use acceptable knowledge in addition to or in place of sampling and analysis, EPA, in enforcement cases, looks for documentation that clearly demonstrates that the information relied upon is sufficient to identify the waste accurately and completely. Documenting both the acceptable knowledge (e.g., knowledge of the process that generated the F-listed or K-listed waste) as well as any analytical data is essential for identifying constituents applicable to LDR standards.

OSWER PBMS

IMPLEMENTATION PLAN

October 9, 1998
(revision 1)

A Cooperative Effort Among:
OSW, OERR, OUST, TIO,
FFRRO, and CEPPO

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EXECUTIVE SUMMARY OF OSWER PBMS IMPLEMENTATION PLAN

The Environmental Protection Agency (EPA) is actively working to implement the President's program for reinventing government and reforming regulatory policy. As a part of these efforts, EPA is working to implement, to the extent feasible, a Performance-Based Measurement System (PBMS) for environmental monitoring in all of its media program offices. As a result, EPA intends that PBMS provide flexibility in conducting required environmental monitoring, expedite the use of new technologies, and result in less costly approaches to conducting required monitoring. Congress and the regulated public have also expressed support for such changes. EPA's Environmental Monitoring Management Council (EMMC), developed a working definition of PBMS and identified guiding principles for EPA to follow. The EMMC then tasked Agency offices, including the Office of Solid Waste and Emergency Response (OSWER), with developing a plan to implement PBMS on a program-specific basis. This document is a result of efforts by the OSWER PBMS Implementation Team in response to this task. Based on this plan, OSWER projects that PBMS will be fully implemented at OSWER by September 30, 1998.

The OSWER Team began development of the implementation plan by using the EMMC's PBMS definition and guiding principles to identify PBMS implementation goals for OSWER. As part of the development process, the OSWER Team also determined to what extent OSWER was already implementing these PBMS principles. The various program offices were asked to identify and describe any projects or tasks that have been completed or are on-going which address the PBMS goals. The Team called the recently completed projects "PBMS victories". The following represent a few of the identified OSWER PBMS victories:

- Promulgation or planned promulgation of new method flexibility language in guidance documents (i.e. SW-846) and *Federal Register* notices.

- Use of information request services or on-line information sources to help educate the public about method flexibility.

- Use of national meetings and symposia as a means to educate the public about method flexibility and regulatory intent.

- Use of training courses and workshops to inform the public and regulators on method flexibility.

- Publication of guidance documents for the public that incorporate a performance-based approach.

The Team also identified barriers or obstacles to the OSWER PBMS goals. Some of these barriers include: misconceptions by both the regulated community and regulators that they could only use promulgated SW-846 methods for RCRA related monitoring and that these methods are intended to be prescriptive with no inherent flexibility, misconceptions by both the regulated community and regulators that the CLP methods are the only methods that can be used for Superfund analyses, and some Federal and State regulations require prescriptive use of RCRA monitoring methods and some regulatory entities prefer that approach.

Based on the PBMS goals and the obstacles, the Team then identified the OSWER implementation needs. The Team identified the need for increased training programs, more

written guidance, and better communication tools to eliminate misconceptions, promote PBMS, and facilitate its implementation. In addition, the review of new Federal regulations and the revision of existing Federal regulations with PBMS in mind needs to be an integral part of the implementation process. The promotion of new and innovative technologies in a manner consistent with PBMS is also essential. Finally, the commitment of additional resources is necessary to implement the plan.

The various program offices within OSWER were asked to include specific information (e.g. regarding milestones, time lines, and resources) about planned and on-going projects. This project information was used to develop a Gantt Chart (Exhibit 1) for OSWER's PBMS related projects. A summary of the estimated extramural dollars and FTEs was also developed (Exhibit 2).

In summary, the development of the OSWER PBMS Implementation Plan revealed that OSWER already is, fundamentally, a PBMS driven program office with many examples of PBMS victories showing its understanding and commitment to the PBMS effort. The development also uncovered the need for additional resources to train affected parties, provide assistance to affected parties, remove barriers, and revise guidance documents. To address these needs, OSWER has initiated specific projects to implement PBMS and the Implementation Plan provides a coordinated, AAship-wide strategy and time line for meeting the DAA's PBMS directive. However, for the plan to be successful, a commitment of additional resources will be necessary.

INTRODUCTION

The Environmental Protection Agency (EPA) is actively working to implement the President's program for reinventing government and reforming regulatory policy. As part of this program, EPA has been working at breaking down barriers to using new monitoring techniques. One barrier is the requirement to use specific measurement methods or technologies in complying with some of the Agency's regulations. EPA's Environmental Monitoring Management Council (EMMC), members of the regulated community, and Congress agree that EPA needs to change the way it specifies monitoring requirements in regulations and permits. There is broad acceptance for Agency-wide use of a nonprescriptive performance-based measurement system (PBMS).

This document, developed by the Office of Solid Waste and Emergency Response (OSWER), presents OSWER's goals and recognized challenges regarding PBMS implementation, and describes OSWER's plans for PBMS implementation. It is the result of a cooperative effort between representatives of various offices or other entities within OSWER. These representatives were members of the OSWER PBMS Implementation Team and periodically met to discuss and develop the contents of this plan.

OSWER projects that PBMS will be fully implemented at OSWER by September 30, 1998.

WORKGROUP PBMS DEFINITION AND GUIDING PRINCIPLES

The EMMC PBMS workgroup defines PBMS as *"a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified, and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner."* PBMS conveys "what" needs to be accomplished, but not prescriptively "how" to do it. Under a performance-based approach, EPAwould specify questions to be answered by monitoring, the decisions to be supported by the data, the level of uncertainty acceptable for making the decisions, and the documentation to be generated to support the PBMS approach in the monitoring program. Data producers will show that their proposed methods meet the specific performance criteria. The criteria may be published in regulations or in technical guidance documents, depending on the individual program.

The EMMC PBMS workgroup also identified the following as their guiding principles:

1. Achieve EPA consensus on a clear set of goals for a performance-based system to select appropriate measurement methods, and present those goals to all stakeholders.

2. Encourage creative approaches to identifying and eliminating, where possible, all obstacles to achieving the goals of the PBMS, including regulations and statutes that inhibit full expression of the concept and the lack of availability of appropriate reference materials.

3. Identify those specific situations, e.g., method-defined parameters, where neither the selection of alternative methods nor the modification of Agency methods is appropriate.

4. Provide specific guidance to assist auditors in reviewing entities that operate under the PBMS, including how to accept or reject methods or method-derived data based upon a comparison with performance criteria.

PBMS BENEFITS

The PBMS approach will provide many benefits to both regulators and the regulated community, including:

- Flexibility in method selection.

- Expedited approval of new and emerging technologies to meet mandated monitoring requirements.

- Development and use of cost-effective methods that meet program requirements and their associated performance criteria.

Thus, the Agency intends that PBMS provide the regulated community with flexibility in conducting required environmental monitoring, expedite the use of new and innovative technologies, and result in a less costly approach to conducting required monitoring. In addition, under PBMS, the use of currently required methods would still be allowed.

PBMS GOALS

The OSWER PBMS Implementation Team identified the following goals of PBMS:

1. Provide a simple straightforward way for laboratories to respond to specific measurement needs with reliable, cost-effective, methods.

2. Emphasize project-specific method performance needs rather than specific technologies to avoid costly measurement overkill.

3. Encourage the use of professional judgement in modifying or developing alternatives to established Agency methods.

4. Provide a consistent way to express method performance criteria that is independent of the type of method or technology.

5. Provide clients with a means to articulate measurement needs in qualitative and quantitative terms, and encourage them to do so.

6. Foster new technology development and continuous improvement in measurement methodology, for example, by providing qualitative and quantitative targets for identified measurement gaps to method developers and other researchers.

7. Encourage feedback of successes as well as failures to expand and disseminate our knowledge of new or modified approaches and the performance of those approaches under real-world conditions.

8. Apply to all Agency measurement and monitoring activities, but recognize that there are situations, e.g., method-defined parameters like the oil and grease

method of the water program and the hazardous waste characteristics of the solid waste program, where neither the selection of alternative methods nor the modification of Agency methods is suggested, as either could yield different, unreliable, and unacceptable data.

OSWER's PBMS CHALLENGE

Before identifying the actions necessary within OSWERto meet the goals of PBMS, the Implementation Team identified situations contrary to those goals. The Team then identified the appropriate actions for the mitigation of these problems. The following problems were identified:

1. A common misconception exists among both the regulated community and some regulators that only promulgated SW-846 methods can be used for all monitoring applications under the Resource Conservation and Recovery Act(RCRA), which is not correct. (SW-846, entitled "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", is the methods manual for the RCRA Program.) An SW-846 method must be used only if the regulation specifies the method as required. Otherwise, any appropriate method can be used. However, the misconception prevents the use of non-promulgated methods for RCRA applications, when such methods are actually appropriate and may be used when complying with most Federal RCRA regulations.

2. A misconception exists that CLP methods are the only methods that can be used for Superfund analyses. CLP methods are very rigid because they are not always adaptable to a particular analytical problem. The regulated community and laboratories could benefit by applying knowledge and experience when modifying the method and thus improving the usefulness of the results.

3. Many RCRA regulations unnecessarily require the use of specific SW-846 methods or SW-846 in general. As a result, SW-846 updates must be issued under a rulemaking. This often delays the availability of needed new or revised methods due to bottlenecks in the regulatory process.

4. State regulations sometimes require prescriptive use of monitoring methods, and some regulatory entities prefer that approach.

5. Communications with OGC and NEIC are needed regarding the PBMS within the context of the regulations to facilitate PBMS implementation and to ensure that OSWER's PBMS implementation proposals do not impair the enforceability of the programs it administers.

Given the above, the PBMS Implementation Team recognized the need for training programs, written guidance, and communications to eliminate misconceptions, promote PBMS, and facilitate its implementation. Training, guidance and communication tools might:

- Educate affected parties regarding the allowed flexibility in modifying existing methods or in using alternative methods to achieve data quality needs.

- Provide assistance to regulatory entities on how to write rules utilizing PBMS language and principles when these rules contain a measurement component.

- Provide assistance to program offices in clarifying their existing PBMS policies, e.g., most Superfund analyses can be run using non-CLP methods.

- Remove barriers caused by misconceptions and expedite the use of new and innovative techniques.

- Help prevent unnecessary and excessive analyses during regulation compliance by encouraging method use flexibility and the use of PBMS.

- Promote the asking of the "right" questions by the regulated community and regulators during monitoring activities.

Finally, the PBMS Implementation Team recognized the need to remove any existing regulatory barriers to implementing a PBMS program, including:

- The revision of existing regulations to remove required uses of SW-846 methods when such requirements are not necessary (i.e., the methods are not required for method-defined parameters).

- The prevention of any future regulatory developmentwhich unnecessarily requires the use of SW-846 methods. This will be facilitated by the aforementioned training and education and through pro-active involvement in the development of rules to ensure that PBMS is implemented. OSWER will also, where appropriate, follow the EMMC QA Panel's "Regulatory Notification Process -- Proposed System to Foster Increased Involvement" (currently in draft form).

- The revision of some regulations to includethe performance criteria necessary for successful PBMS implementation.

OSWER believes that the above actions are representative of and will promote the goals and benefits of PBMS.

OSWER TRAINING INITIATIVE PROPOSED TO ENABLE EASE OF PBMS IMPLEMENTATION

In response to the identified training and education needs, OSWER has developed general training goals for use by interested parties. Using these goals, OSWER intends to provide a series of modules related to PBMS that can be assembled in a manner that is tailored for a particular audience's needs. Modules will also have versions of varying complexity and detail to accommodate needed levels of understanding for different audiences. The following summarizes the types of training modules, the expected audiences, and the intended mode of training:

<u>Types of modules</u>:

A. Understanding of the concepts of PBMS and why it is important to open the door to flexibility in environmental data collection measurement methods. Some of those concepts are:

    - PBMS definition
    - DQO process and outputs
    - QAPPs/SAPs - purpose, content, why we need them

- Reference methods - when these are relevant to PBMS
- What we mean by Method Quality Objectives (MQOs)

B. Regulatory aspects that may affect a PBMS approach

C. Basics of Quality Assurance (QA) and Quality Control (QC)

- What kinds of QC procedures may be appropriate for controlling performance and for describing performance (data quality) that would likely be relevant for most measurement methods that might be encountered in a PBMS approach

- How to use QC information to understand the adequacy of data developed under a PBMS approach

- QA oversight tools for PBMS

D. Options for achieving PBMS

- Selection from a list of methods with performance information (including the "reference method" approach)

- Develop MQOs that evolve from the DQO process (to include all error sources)

E. Writing data acceptance criteria that are not method/technology based and making expectations clear and measurable. This should be part of a project QAPP.

- Example master forms for documenting the QAPP requirements (target analytes, MQOs, QC documentation, etc.) and forms that could possibly be used as part of an Analytical Request will be provided.

F. Data evaluation against MQOs/defined acceptance criteria. This should enable ease of data quality assessment (DQA) that may follow a data validation process.

G. Determination of laboratory capability prior to and during data collection

- Onsite audits and other tools for determining a laboratory's ability to use a PBMS approach

- PE samples

H. Guidance on how a laboratory needsto present its proposal for PBMS and demonstrate the adequacy of the approach.

- This could include example reporting forms (and/or electronic data distribution [EDD]) indicating what should be reported - including results and QC documentation.

I. Determining adequacy of the method prior to allowing/continuing its use.

- Checklist for method performance demonstration

- PE samples - matrix specific

Expected Audiences:

Program and project managers, regulators (State, Regional, other), those designing project data collection activities (DQO team, QAPP/SAP designers), data validators and DQA team, regulated community, Federal facilities, PRPs, data users (e.g., risk assessors and statisticians), laboratory personnel implementing a PBMS approach (and writing laboratory project plans).

Intended Mode of Training

A "train the trainer" approach wherein EPA HQ (OERR and OSW) will provide training to EPA Regions. The Regions will then take over the responsibility of sharing their expertise with other audiences.

OFFICE-SPECIFIC PBMS VICTORIES AND GOALS

In the chapters to follow, each office of OSWER identifies recent activities which served to promote and implement PBMS ("victories") and PBMS-related activities which remain to be completed or implemented ("goals"). The following OSWER offices provided this information: the Office of Solid Waste (OSW), the Office of Emergency and Remedial Response (OERR), the Office of Underground Storage Tanks (OUST), the Technology Innovation Office (TIO), the Federal Facilities Restoration and Reuse Office (FFRRO), and the Chemical Emergency Preparedness and Prevention Office (CEPPO). Some of the offices identified in parenthesis which of the Implementation Team's PBMS goals (listed above) are met by an activity.

I. PBMS IMPLEMENTATION AT OSW

The Office of Solid Waste (OSW) develops guidelines and standards for the management of hazardous, municipal, and industrial solid wastes under the RCRA program; and furnishes technical assistance in solid waste activities. The PBMS-related responsibilities of the Office of Solid Waste are particularly critical to the success of PBMS implementation given that OSW is responsible for the maintenance of SW-846, the methods manual for the RCRA program. OSW also plays a vital role in implementing the hazardous waste management and contaminated site cleanup programs under RCRA. Historically, OSW has always allowed flexibility in method selection and comes closest to implementing the PBMS for the RCRA Program. Simply stated, the RCRA Program typically requires that the analyst demonstrate the ability to determine the analytes of concern in the matrix(ices) of concern at the concentration level of concern at the appropriate confidence level -- an approach which OSW considers to be a first step towards a PBMS approach. The following paragraphs provide specifics regarding most of OSW's victories and goals within the context of PBMS implementation. In summary, OSW is taking the following actions to implement PBMS:

- Removing the mandatory use of SW-846 methodsfrom the RCRA regulations for applications other than method-defined parameters.
- Establishing data quality/performance requirements for RCRA-required monitoring and including the requirements in RCRA regulations on a case-by case basis, to assist regulators and the regulated community in method selection for specific applications.
- Codifying (along with the Regions and other offices as necessary) the required QA and documentation
- Incorporating the PBMS philosophy into new regulations.
- Developing new sampling and testing methodologies which are compatible with the PBMS approach and encouraging their use.
- Encouraging State and local governments, whose regulations often require preapproved, prescriptive testing procedures, to modify their regulations so that the regulated community can take full advantage of the flexibility provided by PBMS.
- Working with EMMC to foster Agency-wide adoption of PBMS.
- Fostering the education of the regulated community and regulators regarding the inherent flexibility of SW-846 methods and application of the PBMS approach during RCRA-related monitoring.

OSWER is well on its way to removing the mandatory uses of SW-846 methods (we have prepared a proposal and it is undergoing OGC review) and establishing DQOs for our various regulations (we have written criteria in the ComparableFuels Rule as a pilot regulation). While much more needs to be done to fully specify additional PBMS programs in RCRA, this document is a plan for implementation and not an exhaustive statement of approaches or solutions. We plan to fully articulate what is needed for any specific RCRA PBMS initiative that we implement in the future, but we are not able to put those details in the plan at this stage because they have not been fully worked out yet.

A. OSW PBMS Victories

The following paragraphs provide a listing and description of past or ongoing OSW PBMS victories.

1. Promulgation of Update III to SW-846

Update III represents the latest update to SW-846 which continues to promote method selection flexibility and the use of reliable, cost effective methods (PBMS goals 1 and 6) for RCRA-related sampling and analysis. SW-846 functions primarily as a guidance document setting forth acceptable, although not required, methods to be implemented by the user, as appropriate, in responding to RCRA-related sampling and analysis requirements. Although method flexibility has long been allowed within the RCRA program, misconceptions still exist among the regulated community and some regulators that SW-846 methods mustonly be used exactly as presented in SW-846 for all RCRA applications. Therefore, as part of Update III, OSW added language to the Disclaimer and Chapter Two (Sec. 2.1) to dispel this misconception and clarify the flexibility in method use and selection inherent to SW-846 (PBMS goals 2, 3 and 5). Copies of these documents are included in the appendix to this plan. Based on public and regulatory need, OSW will continue to update SW-846 by providing new technologies and revised existing technologies and promote cost-effective and reliable analyses. OSW will also continue to use SW-846 updates as a means to clarify analytical flexibility within RCRA and thus promote PBMS.

2. MICE Hotline

The Methods Information Communication Exchange (MICE) Service, or "Hotline", provides answers to questions and takes comments via the telephone, fax, or E-mail, regarding SW-846. Through the MICE service, chemists, ground-water specialists, and sampling experts experienced in and knowledgeable in SW-846 procedures are directly and easily available to the public and regulators involved in RCRA-related monitoring. The MICE Service also assists in the proper application of SW-846 methods, from a regulatory and PBMS view point, by educating the public regarding inherent method flexibility and clarifying whether a method is actually "required" by a particular regulation. The MICE Service also documents existing misconceptions or issues regarding SW-846 method flexibility, and thus serves as the beginning step to problem identification and resolution. As OSW implements other PBMS-related actions, the MICE Service will continue to serve an educational and informational purpose.

3. Waste Testing and Quality Assurance (WTQA) Symposium

The OSW annually co-sponsors the WTQA symposium, which was held this year (1997) on July 6-9 at the Marriott Crystal Gateway in Arlington, Virginia. As part of its efforts to increase the role of the scientific community in the RCRA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) monitoring programs, EPA joined in a partnership with the American Chemical Society to sponsor the WTQA symposium. The symposium was initiated in 1985 as part of EPA's efforts to foster a partnership among the Agency, the regulated community, the public, State regulatory agencies, and other members of the RCRA and CERCLA monitoring community. WTQA has three goals: (1) to serve as a forum for all interested parties to work together to solve RCRA and CERCLA environmental monitoring and waste characterization problems in a cost-effective manner, (2) to give State regulatory agencies and the public timely information about EPA activities that might affect their programs, and (3) to permit the members of the monitoring community an opportunity to exchange information and experiences in using both existing and new monitoring methods and approaches -- which has

promoted all of OSWER's PBMS goals years before Agency-wide interest in PBMS implementation. Thus, the WTQA symposium has always served as an effective means to educate the public and regulators regarding the inherent flexibility of SW-846 methods and to foster new technology development. It has also always served as an effective forum for feedback regarding successes and failures during monitoring and to disseminate knowledge regarding new and modified approaches and their performance in the real-world. In particular, this year's symposium focussed on implementing PBMS, and its impact on the regulated community and testing laboratories. Attendees learned about the newest laboratory methods associated with environmental monitoring and quality assurance/quality control (QA/QC), and how the changes taking place in EPA's measurements program will affect their operations.

4. Articles for environmental magazines

OSW staff frequently contribute articlesto environmental magazines regarding SW-846 and other topics related to monitoring in supportof RCRA regulations. Typically, the articles on monitoring topics serve to educate and inform the public regarding new analytical or sampling methodologies, SW-846 and the regulatory process, the inherent flexibility of SW-846 methods, and the status of various updates to SW-846. Recently, OSW used such articles as an opportunity to promote PBMS and to educate the public regarding its implementation. For example, a recent article in "Environmental Lab" bytwo staff members of the Methods Team of OSW included two PBMS-related sections entitled "Method Flexibility and the Performance-Based Measurement System (PBMS)" and "Method Flexibility and PBMS Initiatives". This information was included to help dispel misconceptions by regulators and the regulated community regarding SW-846 flexibility and to clarify OSW's policy on method flexibility and PBMS.

5. Training courses (e.g., "Analytical Strategy for the RCRA Program: a Performance-Based Approach")

As part of another effort to help dispel misconceptions, OSW provides training courses regarding monitoring under the RCRA program. Of particular note is the training course entitled "Analytical Strategy for the RCRA Program: A Performance-Based Approach". This course, given to Regional and symposium (e.g., WTQA) audiences, has the specific goal of clarifying the monitoring flexibility allowed by SW-846 methods and the RCRA regulations, and to promote and explain PBMS. Basically, the training course explains: (1) the regulatory aspects of RCRA analyses and its true analytical policy; (2) the role of SW-846, its organization and method format, and its correct application for RCRA-related monitoring; and (3) the factors to be considered in the selection of appropriate analytical methods, especially within the context of a PBMS approach.

6. Piloting the PBMS Process with the Comparable Fuel Exclusion of the Combustion Rule

On April 19, 1996, the Agency proposed standards for hazardous waste combustors. The rule, among other topics, included provisions for the exclusion of comparable fuels from RCRA. EPA's goal was to develop a comparable fuel specification which is of use to the regulated community but assures that an excluded waste is similar in composition to commercially available fuel and poses no greater risk than burning fossil fuel. The Agency developed a comparable fuel specification, based on the level of hazardous and other constituents normally found in fossil fuels. For this approach, EPA set a comparable fuel specification such that concentrations of hazardous constituents in the comparable fuel could be no greater than the concentration of hazardous constituents naturally occurring in commercial fossil fuels. Thus, EPA expects that the comparable fuel will pose no greater risk when burned than a fossil fuel and at the same time will be physically

comparable to a fossil fuel, leading to the conclusion that these materials are products, not wastes.

In the proposed rule, the Agency required use of SW-846 during the sampling and analysis of comparable fuels for the exclusion demonstration. The final rule, published in the Federal Register on June 19, 1998 (63 FR 33781), did not require the use of SW-846 methods and instead sets performance-based criteria. This PBMS-compatible approach allows comparable fuel generators to use any reliable analytical method to demonstrate that no constituent of concern is present at concentrations above the exclusion levels. The comparable fuels exclusion measurement criteria will serve as a pilot for the PBMS approach.

As further explained below, OSW will continue to provide support in the development of performance-basedcriteria and PBMS-compatible use of SW-846 in other rulemaking efforts, such as for the Hazardous Waste Identification Rule (HWIR).

7. On-line and CD-ROM Versions of SW-846 and OSW Methods Team Home Page

OSW is continuing its efforts to forge ahead with producing documents in electronic form so that the public can have easier access to them. In addition to producing Version 2.0 of SW-846 on CD-ROM, OSW has recently made available an Internet version of the manual. The URL address is as follows: http://www.epa.gov/epaoswer/hazwaste/test/main.htm.

The On-line version contains all the text, figures and tables found on the CD-ROM and hard copy promulgated versions of the manual, (i.e., all of the SW-846 methods through Update III), as well as the proposed Update IVA methods. In order to make it easier to find a method, the page is laid out by method number (e.g., 3000 series, 8000 series, etc.), rather than by the table of contents. In addition, all of the methods are retrievable in the Portable Document Format (PDF) using the latest version of Adobe Acrobat Reader. We hope to update the SW-846 On-line page as soon as new method updates become available.

In addition to the SW-846 On-line page, you can click a button and return to the main OSW Methods Team Home Page (http://www.epa.gov/epaoswer/hazwaste/test/index.htm). This page describes who the OSW Methods Team is, how to order CD-ROM and hard copies of SW-846, how to contact the MICE service andview answers to frequently asked SW-846 questions, how to view the program and register for the WTQA Symposium, how to get one of your methods into SW-846 by following OSW's Method Development and Approval Process, and what a Performance-Based Measurement System (PBMS) is. There are also sections on What's New and Information Resources, including other program office method hotline numbers.

Version 2.0 of the SW-846 CD-ROM, which is available from NTIS, includes all methods through Update III. The CD uses Adobe Acrobat as the search engine and users can search by the chemical and common name of an analyte of interest, its CAS number, the number of the method, the analytical technique, or a variety of keywords. In addition to the PDF files, the CD also contains the WordPerfect fileswhich allows you to cut and paste methods and chapters to make your own SOPs. You can also print the material including the diagrams and figures from either the PDF files or the WordPerfect files. The system is compatible with both Windows and Macintosh operating systems and is available in both single user and LAN forms. The proposed Update IV methods will be issued as a separate CD-ROM and will include both Updates IVA and IVB.

B. <u>What Needs to be Done by OSW -- Generically</u>

In general, OSW needs to facilitate PBMS implementation by: (1) continuing to educate and train affected parties, (2) assuring consistency with PBMS in new RCRA Federal regulations, and (3) revising existing RCRA Federal regulations for consistency with PBMS and to remove regulation-caused obstacles to PBMS. OSW will review regulations to determine which ones mandate use of a particular method or other measurement technology and determine the approach for implementing changes to make the regulations more compatible with PBMS. In addition, OSW will make sure that the currently recognized method defined parameters be identified to the public and be subject to public comment. OSWER plans to address the method defined parameter issue in the notice to remove the requirements to use SW-846 methods from certain RCRA regulations (i.e., the "methods reinvention reg"). OSW must also work with OERR to implement PBMS.

Regarding future OSWER regulations, OSW will review any to-be-published new or revised regulation that mentions SW-846 to assure consistency with office-wide application of the PBMS approach. OSW monitoring specialists (e.g., the Methods Team) will also provide support in the development of performance criteria, as needed, for new monitoring regulations.

OSW will also continue to review new and innovative technologies for inclusion in SW-846 and continue to update SW-846 (method and chapter revisions) in a manner which is consistent with and promotes the PBMS approach.

PBMS Implementation Obstacles Faced by OSW

Existing misconceptions by both the regulated community and regulators regarding the application of SW-846 methods to RCRA regulations is one significant obstacle faced by OSW. For example, some States do not recognize that other methods besides those in SW-846 can be used for RCRA compliance. OSW plans to mitigate this obstacle through education (see below) and revisions to the Federal RCRA regulations whereby other methods are explicitly allowed.

Some RCRA regulations lack the performance criteria, confidence intervals, or data quality requirements necessary for successful application of PBMS. OSW will work with writers of RCRA regulations in the development of measurement and data quality criteria. The performance criteria will be specified, and data producers can show that their methods meet those criteria. As noted above, OSW has already done this for the comparable fuels final rule, and will be doing this for the HWIR-waste rulemaking.

OSW also needs to communicate with OGC and NEIC regarding the PBMS-related role of SW-846 within the context of the RCRA regulations to help ensure enforcement in a manner which is consistent with regulatory intent from a PBMS standpoint.

In order to adequately validate the methods that they use, the regulated community will need to be able to obtain reference materials whose combination of matrix and analyte pose a challenge to the method that mirrors that of the samples that are being analyzed. For the RCRA and CERCLA programs, such materials are not now available in a wide enough variety to serve the programs' needs. While reference materials may not be available for every RCRA or CERCLA analysis, QC checks such as matrix spikes, matrix spike duplicates and method of standard addition can accurately demonstrate the performance (precision and bias) of any analytical method.

The Agency has recently initiated a cooperative effort with the National Institute of Standards and Technology (NIST) to develop a private sector based reference materials program.

This program, was initiated a few months ago and is being pilot tested using the needs of the Clean Water Act and Safe Drinking Water Act programs managed by the Office of Water and OECA. OSW will need to see the results before we can determine whether this approach would be suitable for OSWER to use.

PBMS Training, Education, and Guidance Development Goals

Both the regulated community and the States need education and training regarding implementation of PBMS during the use of SW-846 methods for RCRA-related compliance. Many States require the use of SW-846 methods, which is often not necessary. In general, OSW needs to educate and train affected parties to assure the most effective and consistent implementation of PBMS.

At a minimum, OSW will continue to educate affected parties by offering training courses (e.g., "Analytical Strategy for the RCRA Program: a Performance-Based Approach") on application of the PBMS approach for RCRA-related measurements. Other, more focused, courses may be required to educate parties, including the States, on the evaluation of measurement data from a PBMS standpoint. OSW will also continue to use the Internet and the OSWER home page, "Monitoring Science in the RCRA Program", to inform users of what OSW is doing regarding PBMS, and will continue to educate the public via professional articles (e.g., within "Environmental Lab" and presentations (e.g., at the annual WTQA symposium). OSW will also develop Fact Sheets on PBMS for use by both the public and the regulators. OSW will introduce regulatory actions related to PBMS through public meetings and workshops as part of the related rulemaking.

C. <u>What Needs to be Done by OSW -- Specifically</u>

OSW has implemented or plans to implement the following specific projects to promote and establish PBMS on an office-wide basis:

1. Removal from the RCRA regulations certain requirements to use SW-846 methods.
2. Revision of SW-846 Chapter Nine (Sampling Guidance)
3. Revisions to Appendix VIII (of Part 261 of the RCRA regulations)

The following pages describe each project and provide specifics regarding project timelines.

OFFICE: Office of Solid Waste (OSW)
DIVISION: Economics, Methods and Risk Analysis Division (EMRAD)

TITLE OF SPECIFIC PROJECT OR REGULATION: Remove Requirements to Use SW-846 Methods from the RCRA Regulations (the "Methods Reinvention Reg")

DESCRIPTION:

The Methods Team of EPA's Office of Solid Waste (OSW) is responsible for developing new analytical methods, sampling and waste handling protocols, and Quality Assurance/Quality Control (QA/QC) methodologies. Once the new procedures are developed, OSW publishes them as Updates or revisions to SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", which is the methods manual for the RCRA Program. Some RCRA-related regulations include the required use of certain analytical and test methods found in SW-846.

The Agency is interested in identifying and removing those regulatory citations which unnecessarily require the use of SW-846 methods. By removing the requirement to use SW-846 in certain regulations (e.g., combustion and delisting), it will be easier for the regulated community to comply given the allowed use of "any reliable method". This approach is consistent with the OSWER PBMS goals, especially goals 2, 3, and 6.

Some of the regulatory requirements specify certain SW-846 methods to determine method defined parameters (e.g., toxicity characteristic) and thus cannot be changed (PBMS goal 8). However, other regulations (e.g., delisting, BIF, and trial burn regulations) simply state that SW-846 in general must be used for compliance. OSW plans to change the language in these regulations to allow flexibility in method selection, whereby the language will be replaced with "SW-846 or other appropriate methodology". This change will not only promote PBMS, but will also remove the need to promulgate every SW-846 update as a rule, and thus save resources and time. Removal of those regulatory requirements will also encourage the timely incorporation of new and innovative technologies into the RCRA methods program.

TIME LINE AND OUTPUTS

Overall Project Start and Completion Dates 5/97 - 12/99

Relevant Milestones*		
Milestone	**Output/Accomplishment**	**Completion Date**
On-line search of RCRA regulations for "SW-846"	Identification of all RCRA regulations which mention the use of SW-846.	May 1997 (updated periodically)
Categorized list of SW-846 regulatory citations	The sorting of all SW-846 citations into several categories (e.g., identification of which involve mandatory "method defined parameters", of others which involve mandatory uses, and of ones which are guidance). This information will be used in determining whether and how the regulatory citations will be revised.	July 1997
OGC input	OGC concurrence regarding OSW's interpretation of which citations involve mandatory applications of SW-846.	Sept. 1997-Sept. 1998
Briefings with affected program contacts and Regional offices	Identification and resolution of any program-specific concerns or obstacles. Education of all affected Agency parties.	Oct. - Nov. 1998
Publication of Proposed Rule	Formal proposal to revise certain regulations whereby the use of SW-846 is no longer mandatory, opportunity for public comment on the revisions.	Dec. 1998
Publication of Final Rule	Promulgation of revisions to the regulations. SW-846 will be more often used as guidance (most updates will not require a formal rulemaking) and regulatory obstacles to PBMS will be removed.	Dec. 1999

* May be revised at a future date to include public meetings.

OFFICE: Office of Solid Waste (OSW)
DIVISION: Economics, Methods and Risk Analysis Division (EMRAD)

TITLE OF SPECIFIC PROJECT OR REGULATION: Revision of SW-846 Chapters Nine and Ten

DESCRIPTION:

Chapters Nine and Ten of SW-846 address the development and implementation of scientifically credible sampling plans for characterizing solid waste. Chapter Nine considers the requirements of the overall sampling plan and Chapter Ten deals with specific sampling techniques for different sampling scenarios. These chapters were published in 1986 and have not been adequately updated to address the increase in knowledge on sampling. The chapters need to better account for the wide range of sample diversity encountered in the RCRA Program.

The purpose of this project is to update Chapters Nine and Ten into user friendly, scientifically sound, statistically correct, legally enforceable, cost-effective documents which also foster and incorporate flexibility and delineate the principles to be considered in a performance-based sampling plan. Updated guidance from the American Society for Testingand Materials (ASTM) will be included. The completed chapters will be published and their availability announced in the Federal Register.

TIME LINE AND OUTPUTS:

Overall Project Start and Completion Dates 7/98 - 9/99

Relevant Milestones		
Milestone	**Output/Accomplishment**	**Completion Date**
Draft of revised chapters	Incorporation of new sampling technologies and the PBMS approach	July 1998
Workgroup review of chapters	Input regarding adequacy and completeness of revisions	March 1999
Final revised chapters	Final incorporation of new sampling technologies and the PBMS approach	August 1999
Publication of Notice of Availability	Revised chapters available to the public	Sept. 1999

OFFICE: Office of Solid Waste (OSW)
DIVISION: Economics, Methods and Risk Analysis Division (EMRAD)

TITLE OF SPECIFIC PROJECT OR REGULATION: Revisions to Appendix VIII

DESCRIPTION:

Appendix VIII of 40 CFR Part 261 is a list of approximately 480 hazardous constituents regulated under Subpart C of the Resource Conservation and Recovery Act (RCRA). EPA is revising Appendix VIII in order to minimize many of the inappropriate uses of this list that have historically occurred. Such misuses have often lead to unnecessary and costly analytical efforts by the regulated community. EPA will begin by breaking Appendix VIII into categories of constituents, based on chemical functionality and other considerations, and in developing a tiered approach to analyses. Each constituent on Appendix VIII will be evaluated to determine if it fits into an EPA-designated subgroup and if it can be reasonably expected to be present or absent in a variety of environmental media or waste matrices. In addition, a study will be undertaken to evaluate the toxicity and related environmental risks of the constituents for use in determining whether the constituents should remain in the appendix.

The constituents recommended for removal from Appendix VIII will include those that would not reasonably be expected to exist in the specific medium of interest, based on stability in the environment or other medium-specific conditions. In addition such constituents will also include those for which analytical methods or standards do not exist, or which were historically produced under such limited circumstances that they do not represent asignificant regulatory concern, or which do not represent a significant environmental risk. The removal of constituents and other appropriate revisions to Appendix VIII will be proposed in the Federal Register, public comments will be addressed, and the revisions will be finalized.

Timeline and Outputs:

Overall Project Start and Completion Dates: 5/97 - 12/99 (projected)

Relevant Milestones		
Milestone	**Output/Accomplishment**	**Completion Date**
Comprehensive study of all 400+ Appendix VIII constituents	Initial identification of constituents to propose for removal from Appendix VIII, and identification of other needed revisions.	May 1997 - June 98
Peer/intra-office review of study, and briefings with affected parties	Identification of technical or programmatic concerns, report revisions	July 1998- Oct. 1998
Development and Publication of Proposed Rule	Formal proposal to revise Appendix VIII	Dec. 1998 - (May be later, depending on testing of model of reformatted appendix)
Addressing of public comments	Revisions to proposed changes as necessary	Summer 1999
Development and Publication of Final Rule	Promulgation of revisions to Appendix VIII	Fall/Winter 1999

D. **Additional Activities That Have Been Initiated Since the 2/20/98 PBMS Implementation Plan Was Adopted**

Cleanup 2000

The RCRA Corrective Action program addresses risk reduction activities and final cleanup at more that 5000 facilities that treat, store, or dispose of hazardous wastes and have the potential for actual environmental contamination. The intent of the Corrective Action is to address cleanup of facilities that have ongoing waste management activities. This program is analogous tot he CERCLA (Superfund) Program, which more routinely addresses abandoned contaminated sites. The program is delegated in 33 states, and we anticipate several more states to receive delegation by the year 2000. As the name suggests, CLEANUP 2000 is a forward-looking effort aimed at achieving real improvements in the speed, effectiveness, and efficiency of the Corrective Action Program. CLEANUP 2000 consistsof numerous interrelated efforts that include a major training program, the HWIR Media & Post Closure Final Rules, and much needed technical and program guidances. These efforts, aimed at advancing the Corrective Action program, are similar in concept to the Superfund Administrative Reforms implemented over the past several years. These efforts can be grouped under the following key objectives: 1. Promote faster cleanups by focusing program on environmental results, not process, with emphasis on prompt controls at high priority facilities. 2. Empower and enhance role of State partners in implementing Corrective Action Program. 3. Enhance public involvement with site-specific cleanup actions, including significant interim measures. 4. Promote innovative yet practical approaches to improve the pace and efficiency of investigations andcleanup actions. 5. Improve national public awareness of program accomplishments. An example of an anticipated major program impact will be stem from the "Remedial Action Plans" contained in the HWIR Media Final Rule. These plans, which are streamlined RCRA permits for wastes from cleanups, will not require facility-wide corrective action (as has been the case in the past). A second example comes from the upcoming Training which will emphasize the responsibility of regulators as "uncertainty managers" as opposed to "uncertainty eliminators." CLEANUP 2000 is also about how we communicate our successes so we all get credit for gains we've already made, the improvements that are in the works currently, and ultimately, the success of what we will achieve over the next several years. Through CLEANUP 2000 we hope to fundamentally shift the RCRA Corrective Action Program toward a "results-driven" implementation. Greater stakeholder involvement and suggestions on how to improve our program are other important benefits we hope to achieve. Currently a brief "fact sheet" is near finalization and we anticipate it will be widely distributed in the very near future. We intend to use a Federal Register Notice, Press Releases, and the Corrective Action website to get the announcement out about CLEANUP 2000. Why the name "CLEANUP 2000"? Because we intend for the discrete efforts and tools to be in place by December 31, 2000. We hope CLEANUP 2000 becomes the RCRA Corrective Action flag that will unite all stakeholders (HQ, Regions, States, Private, Public, Political, etc.) in a charge to capitalize on what we've already accomplished, make meaningful improvements; and, ensure all interested parties are aware of the those improvements.

Corrective Action Training Initiative

OSW has begun implementing a new training initiative for the RCRA Corrective Action program. The primary emphasis of the initiative is to provide and instruct participants on key principles and tools designed to achieve results that protect public health and environment more effectively, efficiently, and more promptly. Although the initiative emphasizes RCRA Corrective Action, the vast majority of the materials are applicable to environmental cleanup actions under any federal (e.g., Superfund)or state authority. The first phase of the initiative, which will start

January 1999, involves holding a 3-day workshop in all 10 EPA regions for EPA and State regulators. The workshop is being designed to be highly interactive and will provide specific tools (e.g., form letters, decision making flow charts, uncertainty management matrices, etc.) that participants will be able to begin using their first day back in the office. Extensive lists of references will be provided with instructions on how to actually get them. The second phase of the initiative involves making the training modules from the workshop available on EPA's RCRA Corrective Action WEB page (www.epa.gov/correctiveaction) for all interested stakeholders to use. Information pertaining to each module is currently available by clicking on the Bridge to Corrective Action Results. By spring 1999, the active learning experience will be launched.

PBMS Regulatory Support

The pilot PBMS Comparable Fuels Rule was promulgated in the Federal Register on June 19, 1998 (63 FR 33781); methods team is currently working on establishing a guidance for how to comply with the rule; in addition, the methods team provided PBMS language for the final HWC MACT rule.

II. PBMS IMPLEMENTATION AT OERR

The Office of Emergency and Remedial Response (OERR) provides policy, guidance, and direction for the Agency's Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and its reauthorization as defined in the Superfund Amendments and Reauthorization Act of 1986 (SARA). The Office develops and implements a program to clean up abandoned hazardous waste sites and to respond to emergencies and accidental releases of contaminants.

A. OERR PBMS Victories

A general description of past and current initiatives of OERR that indicate an OERR PBMS philosophy has existed for several years follows:

1. Use of Field or Screening-Type Methods

Over the past 10 years, OERR has encouraged the use of Field Methods for sample analyses when data quality and documentation needs can be justifiedas "less than definitive." Efforts included the publication of two OERR AOB documents containing "screening" methods and field methods, along with performance information and personal contacts related to those methods. OERR's Emergency Response Team and several Regions also have used Field Methods effectively when data needs permitted.

Region I's development of "Immunoassay (IA) Guidelines for Planning Environmental Projects" is an outstanding example of Regional initiatives where an innovative technology is being fostered, with the intent of reducing time and costs while improving environmental monitoring and remediation activities. According to the Region I document, "IA can provide real-time field analysis of a wide variety of environmental parameters at a fraction of the cost and time of conventional full protocol laboratory analyses." (PBMS goals 2, 3, and 6)

2. Region VII Environmental Collection and Analysis Program or "RECAP"

Even more important was the opening of the door to a new way of doing business when a cooperative effort between the Analytical Operations Branch (now the Analytical Operations Center) and EPA Region VII resulted in the RECAP contract for analytical services largely used by Region VII, along with its ESAT team (in-house laboratory) and the Contract Laboratory Program (CLP). RECAP was the National Pilot Contract for obtaining a full range of analytical services using a contract mechanism that emphasized Regional control and introduced a "turnkey" contract concept. This contract allowed for laboratory flexibility on how to meet project goals. Region VII can demonstrate the value of their approach, describing it as "cost-appropriate," which included not only analytical services but broad field activities as well. The success of the first RECAP pilot contract has led to a Region VII decision to place a RECAP 2 contract. (PBMS goals 1, 2, 3, and 6)

3. Superfund DQO Guidance

When OERR (Superfund) published its draft "Data Quality Objective Process for Superfund- Interim Final" (EPA 540-R-93-071),September 1993, it provided the needed link to facilitate transition to an overall OERR PBMS-driven analyticalapproach. The Superfund DQO

Guidance (flowing from the Agency's DQO guidance, "Guidance for the Data Quality Objective Process - EPA QA/G-4, Final, September, 1994) has established a series of Quality Assurance objectives and identified relevant elements required to support eachobjective. While this is not PBMS in its purest form, it is at least a start in making project personnel aware that it is appropriate to consider a specific data need prior to choosing an analytical method/service for obtaining sample analyses results. It defines only two categories of data ("screening" and "definitive"), both of which lend themselves to a PBMS approach. (PBMS goals 2, 3, 4, 5, and 6)

4. OERR Reorganization

The recent reorganization of Superfund, with a focus on Regional management of projects to a greater degree, also fosters the use of a broader spectrum of analytical methods/services, which was strengthened by the transfer of "Special Analytical Services" from the Headquarters SMO/CLASS contracts to the Regions. As projects become more site-specific (or shifted mainly to PRP or Federal Facilities oversight), the needfor tailored services (as opposed to the limited list of traditional CLP services) has increased.

B. <u>What Needs to be Done by OERR/ERT -- Generically</u>

While OERR has many examples where data users have decreased their use of the CLP, there is little evidence that DQOs for a project have been developed, with the selection of methods/documentation flowing from the DQO outputs. Sampling and Analysis Plans and or Quality Assurance Project Plans, which document the outcome of the DQO process, should contain method quality objectives (MQOs) that provide the acceptance criteria a laboratory needs to understand in order to identify what method(s) and Quality Control procedures/criteria will meet the defined need. Identification of MQOs should take into consideration the magnitude of other-than-analytical error prior to formalizing the MQOs - that is, trade-offs between numbers of samples and method performance (e.g., precision and bias) to arrive at the most cost effective scenario of sampling and analyses that results in data meeting the limits on error.

Examples of how Superfund has demonstrated willingness to use alternative methods/services to CLP (e.g., field methods/screening methods for some purposes) are numerous; however, the alternative methods have generally been prescribed by data users rather than the actual specifications for acceptable data. An example of a truer PBMS approach would be for a data user to define what a measurement method must be demonstrated to accomplish - e.g., selectivity, sensitivity, precision, bias, what potential interferences must be accommodated, what quality and type of documentation it must contain. The laboratory would have the flexibility to use any measurement technology that could be demonstrated to produce the data quality specified.

For PBMS to become a reality in its pure form at OERR, there are many activities that must begin, many of which should be initiated in concert with OERR's sister Office, OSW (and other EPA Offices). In summary:

- OERR must educate and train affected parties inits interpretation of PBMS implementation and in new procedures that result from a PBMS approach.
- OERR should look at ARARs and, in concertwith other Agency programs, identify situations when a particular method is mandatory (as in the first action of OSW's plan) - and follow suit as other programs change regulations to include PBMS.

- OERR should look into how it contracts for analyticalservices and revise policy and procedures to accommodate PBMS. This does not mean that some capacity for the traditional CLP approach need not be maintained - as that need will likely always exist to some degree.

- OERR must develop guidance on how to translate DQOoutputs into realistic MQOs - including the citation of reference methods when it is the most appropriate description of need.

- An approach for the evaluation of laboratories using PBMS should be defined and relevant "checklists" developed, as a starting point.

- Electronic data delivery should be addressed in that an open, flexible EDD format should be used (such as the Department of Energy's DEEMS) that is independent of the analytical method.

- OERR should develop a new approach to data validation that looks at data in the context of how it meets the project DQOs and identified MQOs . This is different, for the most part, from the current prevailing process used by the EPA Regions where "Functional Guidelines" look at data primarily from the standpoint of contractcriteria adherence by a specific technology/method. In addition to looking at data only in the context of its use, looking at how much data need to be validated (e.g., % of project data) and yet assure that they meet project uncertainty goals, should be pursued. Some EPA Regions have initiated more innovative data validation programs.

- OERR should pilot one or more projects in a Region or Regions that embrace the PBMS concept, making sure that adequate documentation is developed to show benefits of a PBMS approach versus using prescribed methods (CLP or other).

PBMS Implementation Obstacles Faced by OERR

Since OERR has been encouraging the use of onsite measurements for many years and has justified the use of quality of different levels based on data use in its DQO guidance, few obstacles are anticipated in acceptance of the idea of PBMS as it relates to selection of a method from a series of options that contain performance information(i.e., reflecting the analytical error in such terms as precision and bias and confidence intervals). However, PBMS adoption in its broadest possible interpretation (providing qualitative and quantitative performance criteria that are not technology-dependent) will be difficult, since there is little or no experience in translation of DQO outputs to MQOs.

PBMS Training, Education, and Guidance Development Goals

Initially, OERR will develop guidance as described below in numbers 1 and 3 under section C, "What Needs to be Done by OERR --Specifically."

C. <u>What Needs to be Done by OERR/ERT - Specifically</u>

While all of the items listed in section "B" above need to be done, OERR has chosen the following five projects to help promote and establish PBMS on an office-wide basis (items 1, 2, and 3 should build on the Region VII experience with RECAP):

1. Develop guidance for the Regions on the PBMS approach, emphasizing the benefits of adoption of this approach and providing step-by-step procedures on how to implement the approach. "Buy-in" from the Regions - at least a few of them to start - will be critical to successful PBMS implementation. The guidance can be used by other interested parties.

2. Identify one or more Regions to pilot PBMS concepts to learn where the problems will occur and to develop solutions to those problems. Selection ofthe Region(s) should be based on Regional interest in PBMS and demonstrated sophistication in the DQO or a similar planning process.

3. Provide hands-on training in the development of MQOs flowing from the DQOs, to lead to the development of the QAPP with the acceptance criteria for method performance. Since this is a new approach for anyone defining analytical methods to be used for a project (rather than citing the specific methods to be used), the process will likely need to emerge from pilot projects involving interested Regions. The role that the sampling design plays in meeting project requirements must be emphasized and its effect on MQOs understood.

4. Lead and track Regional efforts to develop Regional PBMS Implementation Plans

5. If the Contracts 2000 Work Group makes a decision to continue procurement of analytical services under centralized Headquarters contracts (like the CLP contracts), it should design more flexibility into the SOWs to allow for alternate methods and QC to accommodate broader analytical needs. In addition, regardless of whether Contracts 2000 decides on central contracting specifically for analytical services, an array of analytical services should be designed to allow for various contractual options for meeting analytical needs. One or more of the sources of analytical services should emphasize the use of PBMS through contracts that allow the contractor to identify the means to meet project goals. In addition, the same, or different, contracts could provide for the "traditional" services to be used when they are appropriate in lieu of PBMS. The analytical services program design could be either for national Superfund use or for Regional implementation/use - or both. Decisions on contracts would be the responsibility of the Contracts 2000 workgroup.

The following pages describe each project and provide specifics regarding project time lines. The milestone dates are tentative and will be finalized in work planning sessions in October 1998.

OFFICE: Office of Emergency and Remedial Response (OERR)

TITLE OF SPECIFIC PROJECT OR REGULATION: Development of PBMS Guidance for Defining Sample Measurement Needs

DESCRIPTION:

Traditionally, most analytical work performed for Superfund was obtained through the Contract Laboratory Program (CLP) contracts, Special Analytical Services (funds now provided directly to the Regions), and the Regional Environmental ServicesAssistance Teams (ESAT). Generally, through all of these mechanisms, the methods of analyses/measurement were EPA "standard" methods including rigorous quality control and extensive documentation. There was little thought to actually identifying acceptance criteria for data based on the purpose of the data and allowing data generators to propose how best to meet theneed. In the past, the funding for these three contractual mechanisms for obtaining sample analyses came from Headquarters and Superfund dollars helped to continue proliferation of this practice.

The prevailing attitude about analytical services and a prescriptive approach was right for the times when Superfund came into being, as often, little was known about site contamination. Also, there was an emphasis on the need to notonly apply the best EPA method to the problem, but to document all that had been done relative to that sample because of the eventuality of litigation. At this point in time, the Superfund pipeline does not contain many of those sites with unknown problems, but rather those for which characterization is complete, problems of contamination are known, and often they have been taken over by PRPs. That combination of circumstances encourages the use of a planning process (e.g., DQO) that looks toward the end use of the data prior to design of the sampling plan and scheme for analysis/measurement of samples. In order to encourage the use of PBMS (and the DQO process), it is important to assure that EPA (and State) personnel that are responsible for making Superfund decisions and contractors providing assistance, designing QAPPs and SAPs, reviewing and validating data, and PRPs (including Federal Facilities) understand the basic concepts of PBMS, its benefits, and how to implement the approach.

TIME LINE AND OUTPUTS:

Overall Project Start and Completion Dates: 5/98-10/98.

Relevant Milestones		
Milestone	**Output/Accomplishment**	**Completion Date***
Identify audience(s) for the guidance(s), propose the scope (with the help of the affected parties - audience), and develop an outline	Affected parties (e.g., those who must implement PBMS or use the data) help shape the guidance to be what is needed; a clear outline for review prior to writing the guidance. This is like a statement of requirements.	May 31, 1998
Establish working group for writing the guidance (may involve some contractor work assignments), and make writing assignments	Action items articulated and responsibilities and authorities defined.	May 31, 1998
Draft Guidance distributed for review to appropriate EPA (and other - e.g., Federal Facilities).	A document to use to start training modules and to assure that needs are being met.	August 1998
Finalize and distribute the PBMS Guidance	Guidance available for Regions.	October 1998

*Tentative

OFFICE: Office of Emergency and Remedial Response (OERR)

TITLE OF SPECIFIC PROJECT OR REGULATION: Regional Pilot for Implementation of a PBMS Approach

DESCRIPTION:

See project description for "Development of PBMS Guidance for Defining Sample Measurement Needs"

TIME LINE AND OUTPUTS:

Overall Project Start and Completion Dates 5/98-10/99

Relevant Milestones		
Milestone	**Output/Accomplishment**	**Completion Date***
Development of expectations for the pilot. Evaluate RECAP's success to aid in design.	Articulation of the need/requirement for the Regions' use in accepting a role as a pilot Region. Determine if the Region 7 RECAP already meets the requirements of a pilot.	May 1998
Survey Regions for appropriate pilot(s) site and select.	Identification of responsibility for pilot.	May 1998
Regional plan developed and provided to Superfund for review and comment and acceptance.	Agreement on what is expected.	August 1998
Regional implementation of pilot, draft report, and final report.	Documentation of problems and benefits of PBMS.`	October 1999

*Tentative

OFFICE: Office of Emergency and Remedial Response (OERR)

TITLE OF SPECIFIC PROJECT OR REGULATION: Training in Development of MQOs and Other Training Modules.

DESCRIPTION:

Superfund has traditionally used a more prescriptive approach to sample analyses. Frequently, resources may not be available to support the need for technical expertise that will prevail under a DQO process leading to PBMS and MQOs that need to be specified. As a tool to help implementors, training in how to transform outputs of the DQO process into acceptance criteria for analytical data must be developed. The role that the sampling plan (types and numbers of samples as well as representative sampling points) plays in determining the MQOs must be clear. As the MQO development training module is developed, additional training modules relevent to implementation of PBMS will also be developed.

TIME LINE AND OUTPUTS:

Overall Project Start and Completion Dates: 9/97-12/98

Relevant Milestones		
Milestones	**Output/Accomplishment**	**Completion Date***
Enlist ORD/QAD support	Obtains Agency expertise in the DQO process and intent - lending integrity to the task.	September 1997
Definition of needs/ requirements - contractor support required.	Assurance of completeness of training.	May 1998
Draft training outline and summary of expected benefit/value of each element.	Assures not wasting time on items with little or no value.	July 1998
Develop training modules and distribute as a draft to Regions, etc. for review and comment.	Assures on the right track.	September1998
Finalize training modules.	Needed for implementation	November 1998
Start training.	Some trained personnel ready to go forward with PBMS.	December 1998

*Tentative

OFFICE: Office of Emergency and Remedial Response (OERR)

TITLE OF SPECIFIC PROJECT OR REGULATION: Development by Regions of PBMS Implementation Plans

DESCRIPTION:

As guidance and training are provided, the Regions will be asked to develop their own Regional plans for implementing a PBMS approach and will be tracked according to their plans.

TIME LINE AND OUTPUTS:

Overall Project Start and Completion Dates: 7/98-9/98

Relevant Milestones		
Milestones	**Output/Accomplishment**	**Completion Date***
Headquarters Request to Regions for implementation plans, with guidance for their development.	Responsibilities and expectations for Regions are articulated.	July 1998
Development of Regional Implementation Plans - using the Headquarter's guidance	A schedule for when the Superfund Program will be nationally and actively working towards a PBMS approach.	September 1998

*Tentative

OFFICE: Office of Emergency and Remedial Response

TITLE OF SPECIFIC PROJECT OR REGULATION: Design of an Array of Analytical Services Emphasizing a PBMS approach. (Traditional services may still have to be provided to be available when needed.)

DESCRIPTION:

See project descriptions for "Development of PBMS Guidance for Defining Sample Measurement Needs" and "Regional Pilot for Implementation of a PBMS Approach"

TIME LINE AND OUTPUTS:

Overall Project Start and Completion Dates: 6/98-2/99

Relevant Milestones		
Milestone	**Output/Accomplishment**	**Completion Date***
Development of relevant work group to design array (could be led by AOC)	Assures that an appropriate and diverse group defines needed set of services and how to divide them between traditional needs and a PBMS approach.	June 1998
Determination of whether to have a national program, Regional only, or both. (Under cognizance of the Contracts 2000 group)	Helps design of procurement types.	Completion expected in early 1998.
Initial design and draft SOW(s)	Review product to assure most needs are covered.	July 1998
Model procurement packages developed	Helps Regions implement PBMS concepts in contracts	November 1998
Distribution of model to support contractors, PRPs, etc., to share OERR perspective on how to implement PBMS.	Reaching out to other potential users.	December1998
CBD announcements for RFPs (or combined IFB/RFPs)	Start the procurement process.	February 1999

*Tentative

D. Additional Activities That Have Been Initiated Since the 2/20/98 PBMS Implementation Plan Was Adopted

ERT-Edison, NJ continues to use PBMS. Recently ERTC purchased field portable Hapsite GC/MS for monitoring VOC s in the field. The methods are being developed to perform air analysis for various organic compounds. The ERTC is planning to use Hapsite GC/MS in the field during early 1999.

III. PBMS IMPLEMENTATION AT OUST

The Office of Underground Storage Tanks (OUST) develops guidelines and standards for, and provides technical assistance on, underground storage tanks. The main contribution of OUST toward the implementation of PBMS at OSWER includes outreach and educational activities promoting the use of field analytical methods instead of more conventional EPA-approved methods during the monitoring of underground storage tanks. These activities are described below

A. <u>OUST PBMS Victories</u>

The following paragraphs provide a listing and description of past or ongoing OUST PBMS victories.

1. Site Assessment Manual

OUST has published a site assessment manual and distributed over 7,000 copies to Federal and State UST/LUST regulators. The manual includes a chapter on field analytical methods for petroleum hydrocarbons. For each applicable method, the chapter discusses the operating principles, describes the method of analysis, and outlines the method capabilities and limitations. In this way the reader learns when each method is appropriate. This activity relates to PBMS in that it promotes the use of appropriate field analytical methods, rather than requiring use of a specific EPA-approved method. (PBMS goals 2, 3, 5, 6 and 7)

2. Site Assessment Workshops

OUST has organized and conducted several site assessment workshops with State regulators. The workshops promote the use of field analytical methods. One workshop was conducted in Chicago by the Region 5 UST section, April 4-6, 1995, for Region 5 States. Another workshop was conducted in San Antonio, Texas, September 16-18, 1996 for Region 6 and 7 States. These workshops provided States an opportunity to learn about field methods for analysis of petroleum hydrocarbons and when the methods are appropriate. (PBMS goals 2, 3, 5, and 7)

3. National Conferences

Field analytical methods are commonly promoted during OUST's national conferences. During the past three conferences separate sessions were devoted to site assessment issues, including field analytical methods. These national conferences occur every year in March and are typically attended by over 300 State and Federal UST/LUST regulators. Each of these sections in the past three years has encouraged the use of field analytical methods for petroleum hydrocarbons and discouraged the belief that only EPA-approved methods should be used to collect data at LUST sites. (PBMS goals 2, 3, 5, 6, and 7)

4. State Fund Administrator Conferences

OUST has organized site assessment sessions at State fund administrator conferences (yearly conferences for the managers of State agencies that pay for remediation at LUST sites). As with the national conference, thesesessions encouraged the use of field analytical methods for petroleum hydrocarbons and discouraged the belief that only EPA-approved methods should be used to collect data at LUST sites. (PBMS goals 2, 3, 5, 6, and 7)

5. Field Methods Manual

In 1990, OUST published and distributed to State and Federal UST/LUST regulators a manual on field analytical methods entitled "Field Measurements: Dependable Data When You Need It." This manual provided regulators with descriptions of field analytical methods (e.g., Draeger tubes, the Hanby colorimetric test kits, field gas chromatographs) that could be used to collect more data, more quickly at LUST sites. (PBMS goals 2, 3, 5, and 7)

B. What Needs to be Done by OUST -- Generically

In general, OUST needs to facilitate PBMS implementation by continuing to promote PBMS through the various outreach activities undertaken in the past, including sessions at the national conference, State fund administrator conferences, and workshops. The specifics of these activities cannot be described at this time because they will be developed in cooperation with State UST programs when requested.

OUST will also work with OSW in developing fact sheets on PBMS and distributing them to the LUST regulating community. OUST can also place this fact sheet and other relevant information on our home page.

In order to adequately validate the methods that they use, the regulated community will need to be able to obtain reference materials whose combination of matrix and analyte pose a challenge to the method that mirrors that of the samples that are being analyzed. For the RCRA and CERCLA programs, such materials are not now available ina wide enough variety to serve the programs' needs. While reference materials may not be available for every RCRA or CERCLA analysis, QC checks such as matrix spikes, matrix spike duplicates and method of standard addition can accurately demonstrate the performance (precision and bias) of any analytical method.

The Agency has recently initiated a cooperative effort with the National Institute of Standards and Technology (NIST) to develop a private sector based reference materials program. This program, was initiated a few months ago and is being pilot tested using the needs of the Clean Water Act and Safe Drinking Water Act programs managed by the Office of Water and OECA. OSW will need to see the results before we can determine whether this approach would be suitable for OSWER to use.

C. What Needs to be Done by OUST -- Specifically

As noted above, OUST cannot specify project-specific information (i.e., project titles, descriptions, timelines or outputs) or the resources that will be needed for the above general activities at this time. OUST will dedicate 0.1 FTE to educating States about PBMS through the various trainings and presentations. OUST expects to spend $40,000 on specific workshops in FY 98. An additional $5,000 may be spent on invitational travel for experts to give presentations at national conferences and meetings.

IV. PBMS IMPLEMENTATION AT TIO

The Technology Innovation Office (TIO) promotes the use of innovative technologies for the monitoring and evaluation of contaminated soil and groundwater; a mission which in itself embodies PBMS goals.

A. TIO PBMS Victories

The following paragraphs provide a listing and description of past or ongoing TIO PBMS victories.

1. The ETV Consortium for Site Characterization Technology (CSCT)

As a pilot under Environmental Technology Verification (ETV) Program, the Consortium was established to increase the application of innovative site characterization by providing a mechanism for the EPA verification of the performance of the technologies. The CSCT seeks to (1) identify, demonstrate, evaluate, verify and transfer information about innovative and alternative monitoring, measurement, and site characterization technologies to developers, users, and regulators; and (2) define and demonstrate a process for verifying the performance of innovative site characterization technologies

The Consortium employs a third-party verification organization (DOE National Laboratory) to develop demonstration plans, conduct the evaluations, and write the final reports. Based on the assessment of the needs of users, the Consortium annually solicits available vendors, selects appropriate technologies, and fields performance evaluations. Technologies are selected based on their applicability to the identified category of need, their maturity (commercially ready, full-scale field units), and the willingness of the vendors to participate. After the field evaluation, the Consortium produces reports on each technology accompanied by a verification statement signed by the Director of EPA's National Exposure Research Laboratory. Of the 12 technologies field tested in 1995, verification statements and evaluation reports by the CSCT are available as follows:

1. Cone Penetrometer/Laser Induced Fluorescence (2 technologies)
   Verification Statements, signed 2/10/97, available on home pages
   Evaluation Reports

2. Field Portable X-Ray Fluorescence (5 technologies)
   Verification Statements, signature pending
   Evaluation Reports

3. Field Portable Gas Chromatography/Mass Spectrometry (3 technologies)
   Verification Statements, signature pending
   Evaluation Reports

(PBMS goals 1, 6, 8)

2. Status Report on Field Analytical and Characterization Technologies

TIO is now reviewing the final draft of this report which compiles data collected from the Regions on past applications of innovative field technologies such as XRF, LIF, and immunoassay techniques. The report establishes baseline information on approximately 100 sites at which

innovative characterization technologies have been used to date. The report can be used to show project managers where the technologies have been employed before and to give them a point of contact for each application who may be able to answer questions and concerns about the technologies. (PBMS goals 2, 3, 6, 7)

3. EPA/Navy Field Analytical and Sampling Technology Screening Matrices and Reference Guide

The U.S. Navy and the U.S. EPA are in the process of developing a technology screening matrix for field analytical and sampling technologies modeled after the Air Force/EPA treatment technologies matrix developed in 1993. It is intended to provide, in a poster format, comparative screening information on analytical and sampling technologies. The goal of the matrix is to ensure that project managers and site stakeholders are aware of the full-range of technology options available to them to assess and characterize contamination at their sites (PBMS goals 2, 5, 6, 8).

4. Site Assessment and Characterization Processes -- Case Studies

EPA and the Federal Remediation Technologies Round table (FRTR) are coordinating efforts to begin fully documenting the application of expedited site assessment/characterization processes and the implementation of field analytical and innovative sampling technologies. (PBMS goals 6, 8)

5. Field-Based Characterization Technology Workshop

TIO has developed a training course as part of the curriculum of the CERCLA Education Center to train EPA project managers on the technologies involved in the assessment and characterization of hazardous waste sites. The primary focus is the description of innovative field methods and their applicability to site clean-up programs and it will include a number of "hands-on" exercises to acquaint participants with the operation of the technologies. (PBMS goals 2, 3, 6)

6. Expedited Site Characterization Guidance/Presumptive Characterizations

TIO is working with the Superfund and RCRA corrective action programs to provide guidance to EPA staff on the use of expedited processes and the applicability of expedited site characterization and field technologies to the waste programs. This effort will include a compilation and analysis of the various processes currently being employed by other organizations (DOE SAFER, Argonne's "Quicksite," ASTM's standard on expedited site characterization, etc.). (PBMS goals 1, 2, 5, 8)

7. Brownfields

The Brownfields program seeks to promote the economic redevelopment of abandoned industrial sites. The challenge of Brownfields programs is to quickly address environmental issues and advance sites towards viable, economic uses. The ability to expeditiously determine the presence and extent of contamination are features of field analytical and innovative sampling and monitoring technologies that could potentially make them very attractive for use at Brownfields sites.

Two Brownfields information resources initiatives are underway to promote the use of these technologies in Brownfields programs. First, TIO has developed the *Road Map to Understanding Innovative Technology Options for Brownfields Investigation and Cleanup* to help

Brownfields site decision makers, many of whom do not have extensive experience in hazardous waste site assessment and cleanup, to understand the innovative technology options available to them for characterization and cleanup. It shows these stakeholders, as they move through the clean-up process what technology options are relevantand the issues they must consider. The Road Map is linked to an accompanying *"Tool Kit of Information Resources for Brownfields Investigation and Cleanup"* which describes the information resources developed by EPA to support innovative characterization and clean-up technologies. The Tool Kit contains resources to describe the technologies more fully, once a stakeholder has determined an option to be applicable to their situation. Both emphasize field characterization options that may be available to support Brownfields assessments (PBMS goals 1, 2, 5, 8).

8. The Vendor Field Analytical and Characterization Technologies System (FACTS) Database

Vendor FACTS is a searchable, electronic database of field analytical and characterization technologies. Information on specific technology applications and performance (as provided by the vendors) can be searched by media, contaminants, technologies, vendors, etc., to determine appropriate technologies and their availability for a specific site need. Version 2.0 contains information on 129 analytical, sampling, geophysical, and extraction technologies.(PBMS goal 6)

9. Public Events

The Consortium has participated in the Association of State and Territorial Solid Waste Management Official's "1997 CERCLA Innovative Technology Workshop" in Long Beach, California, August 18-20, 1997. Site characterization and remediation technology vendors have been invited to exhibit their technologies during this workshop to introduce State CERCLA managers to the policy implications and technical considerations needed to determine innovative technology acceptance. At this workshop, State staff will have the opportunity to examine technologies of participating vendors.

The "Environmental Clean Up Technologies Conference - Midwest Marketplace", July 22-23, 1997, include the ETV on the agenda as well as the Site Characterization exhibit booth in the exhibit area. This conference objective is to provide information on business opportunities for environmental clean up and site characterization technologies at the State and Federal levels, the private sector, and international markets. (PBMS goal 6)

10. Internet Sites

The Hazardous Waste Clean-up Information (CLU-IN) world wide web site provides information on innovative treatment and site characterization technologies to the hazardous waste remediation community. The site offers a variety of information and services to Federal and State personnel, consulting engineers, technology developers and vendors, remediation contractors, researchers, community groups, and individual citizens.

TechDirect is another on-line information service that highlights new publications and events of interest to site remediation and site assessment professionals. Subscribers will receive periodic E-mail messages describing the availability of publications and information on upcoming events.

B. What Needs to be Done by TIO -- Generically

In general, TIO needs to continue to promote PBMS in its office through the actions described below.

1. Fulfill the need for independent evaluation of monitoring and site characterization technology performance (PBMS goals 1, 6, 8)

The field of environmental monitoring and site characterization technology is evolving rapidly. However, few true innovations in monitoring and site characterization are making it into routine use at sites across the nation. Many hurdles and pitfalls exist along the path to commercializing environmental technologies. Obstacles include: problems convincing regulators and potential customers that the product can meet its claims; lack of credible performance data and access to unbiased third parties to evaluate the data; and difficulty in identifying places where the technology can be tested.

Many of the hurdles for innovative technologies are linked. Customers will not buy a new technology until the regulators say it is approved for use. Investors will not invest until a clear market for the product is defined and the product can achieve some sort of regulatory acceptance. The regulator will not allow its use until convinced by credible performance data that the product can meet its performance objectives. Achieving success in persuading customers and regulators across the country is a repetitive, time consuming effort.

The Consortium for Site Characterization Technology will continue to fulfill the need for independent evaluation by bringing together the interests of Federal and State regulators, Federal technology evaluation and verification organizations, and potential end users of these technologies to facilitate independent verification of technology performance.

2. Foster communication exchanges between technology users (PBMS goals 2, 3, 6, 7)

TIO will continue to collect information from RPMs and OSCs in the Regions on the performance of site characterization technologies used in the field. In addition to performance data on a technology used at a site, an EPA site manager is identified as the point of contact to answer questions or exchange information on technologies used. Information collected will be published in the annual Status Report on Field Analytical and Characterization Technologies. The first report will be published around September 1997.

3. Provide reference source for comparison between competing technologies (PBMS goals 2, 5, 6, 8)

TIO is finalizing "The Field Sampling and Analysis Technologies Matrix and Reference Guide" which serves as an initial screening tool to site managers and provides much needed comparison between competing technologies.

4. Document the application of expedited site assessment (PBMS goals 6, 8)

TIO will perform case studies on certain technologies to foster new technology development and technology acceptance by RPMs and OSCs. A case study on rapid site investigation activities conducted at New Orleans Brownfields sites is being developed by TIO to support the field-based characterization workshop. This case study will document the use of field

technologies at the New Orleans sites and provide information on costs, performance, advantages, limitations, etc. of using field technologies and an expedited approach.

5. Training (PBMS goals 2, 3, 6)

TIO is training site managers across the Regions on technologies to assess and characterize hazardous waste sites. TIO will use training objectives identified by the workgroup to develop additional courses to facilitate the implementation of the PBMS concept across the Agency.

6. Provide guidance on the use of expedited site characterization technologies (PBMS goals 1, 2, 5, 8)

TIO will continue to work with the Superfund and RCRA corrective action programs to provide guidance on the use of these technologies. In addition, TIO will continue to work on developing "presumptive" site characterizations for four common site types. By developing templates for characterizing sites common to the Superfund, RCRA Corrective Action, and Brownfields programs, the project seeks to increase EPA understanding and acceptance of field technologies by showing where reliable field methods can best be employed.

7. Information resource for Brownfield sites (PBMS goals 1, 2, 5, 8)

TIO is working on documents to identify the range of technology options available to Brownfields stakeholders and to describe EPA information resources available to help better understand the options. The "Road Map to Understanding Innovative Technology Options for Brownfields Investigation and Cleanup" is now to government employees free of charge from NCEPI and to the private sector at cost from NTIS. The "Tool Kit of Information Resources for Brownfields Investigation and Cleanup" should be available by the end of August.

8. Database on site characterization technologies (PBMS goal 6)

TIO will continue to collect the latest vendor information on new technologies for site characterization and disseminate such information to site managers. Version 2 of the Vendor Facts database was released early this year and listed 129 field portable technologies

C. <u>What Needs to be Done by TIO -- Specifically</u>

TIO has or will continue to implement the projects listed above. TIO will also work on projects or initiatives identified by the workgroup and falling within TIO's mission to support the development and implementation of the PBMS concept across the Agency. Specific project reports, as of July 22, 1997 are listed below, each are described in the pages to follow.

1. CSCT Evaluation Reports/Verification Statements
2. Upcoming Verification Projects
3. Promoting State Acceptance - CSCT Collaboration with the Interstate Regulatory Cooperation (ITRC) Work Group
4. Promoting Regional Acceptance - The EPA Regional Network of Site Characterization Contacts
5. Public Events
6. Encyclopedia of State Use of Innovative Site Characterization Technologies: *A compilation of innovative site characterization technologies*

7. Field-Based Site Characterization Technology Training Course
8. Expedited Site Characterization Guidance/Presumptive Characterizations

OFFICE: Technology Innovation Office

TITLE OF SPECIFIC PROJECT OR REGULATION: CSCT Evaluation Reports/Verification Statements

DESCRIPTION:

The Consortium employs a third-party verification organization (DOE National Laboratory) to develop demonstration plans, conductthe evaluations, and write the final reports. Based on the assessment of the needs of users, the Consortium annually solicits available vendors, selects appropriate technologies, and fields performance evaluations. Technologies are selected based on their applicability to the identified category of need, their maturity (commercially ready, full-scale field units), and the willingness of the vendors to participate. After the field evaluation, the Consortium produces reports on each technology accompanied by averification statement signed by the Director of EPA's National Exposure Research Laboratory.

TIMELINE AND OUTPUTS:

On-going. A number of demonstration reports are in different phases of review and evaluation.

OFFICE: Technology Innovation Office

TITLE OF SPECIFIC PROJECT OR REGULATION: Upcoming Verification Projects

DESCRIPTION:

The second cycle of demonstrations began with the soil and soil gas sampling events held in early June. Dates for "Visitors' Days" held in conjunction with the field events are shown below:

1. Sampling technologies (soil and soil gas) (completed)	June 5, 1997, Albert City, IA June 12, 1997, Commerce City, CO (completed) Report - First draft under development
2. Analytical technologies for measuring PCBs in soil, water and sediments	July 24, 1997, Oak Ridge, TN (completed) Report - First draft under development
3. In-situ (well-head) monitoring	September 18,1997, Savannah River, SC Sept 25, 1997, McClellan AFB, CA
4. Sampling design software	December 8-12, 1997
5. Field Extraction	Dates and locations to be determined
6. Sampling technologies (groundwater)	Dates and locations to be determined

All Consortium stakeholders are invited to participate in the visitor's days events.

TIMELINE AND OUTPUTS:

On-going

OFFICE: Technology Innovation Office

TITLE OF SPECIFIC PROJECT OR REGULATION: Promoting State Acceptance - CSCT Collaboration with the Interstate Regulatory Cooperation (ITRC) Work Group

DESCRIPTION:

The CSCT works with the Accelerated Characterization Subgroup of the ITRC. At the general meeting held June 2, 1997, in Virginia, the CSCT provided a schedule of "input" points for State participation. Based on interaction over the next 3 months, the ITRC will determine the need for continued involvement. Nine States have agreed to participate in the Subgroup to track the CSCT process. Four States (MA, LA, MD, NJ) participated in the July PCB analysis visitor's day demonstration. Several will participate in well head monitoring. States are awaiting completion of soil / soil gas reports for review.

TIMELINE AND OUTPUTS:

On-going

OFFICE: Technology Innovation Office

TITLE OF SPECIFIC PROJECT OR REGULATION: Promoting Regional Acceptance - The EPA Regional Network of Site Characterization Contacts

DESCRIPTION:

This group was formed within the Regional Waste Division and labservices to raise awareness of the Environmental Technology Verification (ETV) and the Consortium for Site Characterization Technology (CSCT) program and outputs. Regionalnetwork conference calls are held on a bi-monthly basis and face-to-face meetings are planned on an annual to semi-annual basis. A number of issues have been identified by Network members, including the need for: concise information for distribution; recognition by Regional management; alternatives to SW-846 for QA/QC; and a proposal for a site characterization "Forum."

TIMELINE AND OUTPUTS:

See DESCRIPTION above

OFFICE: Technology Innovation Office

TITLE OF SPECIFIC PROJECT OR REGULATION: Public Events

DESCRIPTION:

The "Environmental Clean Up Technologies Conference - South Central Marketplace", November 13-14, 1997, includes the ETV on the agenda as well as the Site Characterization exhibit booth in the exhibit area. This conference objective is to provide information on business opportunities for environmental clean up and site characterization technologies at the State and Federal levels, the private sector, and international markets.

TIMELINE AND OUTPUTS:

See date above.

OFFICE: Technology Innovation Office

TITLE OF SPECIFIC PROJECT OR REGULATION: Encyclopedia of State Use of Innovative Site Characterization Technologies: *A compilation of innovative site characterization technologies*

DESCRIPTION:

This encyclopedia is an electronic report/database on analytical technologies, organized by contaminant and media to serve as "front end" descriptive information on technologies. It is useful as an initial screening tool to identify technologies suitable to characterize a contaminated site. It is intended to tie together a number of existing or planned information tools including the EPA/Navy Technology matrix, the Vendor FACTS database, and the Field Analytical and Characterization Technologies status report.

TIMELINE AND OUTPUTS:

The basic structure has been completed and TIO will work throughout FY 1998 to develop the electronic database for use on the CLU-IN web site

OFFICE: Technology Innovation Office

TITLE OF SPECIFIC PROJECT OR REGULATION: Field-Based Site Characterization Technology Training Course

DESCRIPTION:

As part of EPA's CERCLA Education Center program, this course provides a description and hands-on experience on innovative site assessment, characterization and analytical technologies. A short version of the course was conducted during the ASTSWMO conference in Long Beach (see "Public Events" above).

TIMELINE AND OUTPUTS:

Two more deliveries are budgeted for 1997

OFFICE: Technology Innovation Office/OERR

TITLE OF SPECIFIC PROJECT OR REGULATION: Expedited Site Characterization Guidance/Presumptive Characterizations

DESCRIPTION:

EPA will begin developing "presumptive" site characterization templates for four common site types. The project is currently in the data collection phase--compiling current activities by Federal agencies, commercial entities, academia. After analyzing the collected data, templates will be developed. The data collection and analysis phase should be completed by the end of the summer. The goal is to support the development of better guidance for regional staff on the use of expedited site characterization technologies and practices.

TIMELINE AND OUTPUTS:

The initial inventory of expedited processes is completed and work is underway to develop a general template. This template will guide the development of the specific site guides. Work will be on-going throughout FY 1997 and 1998.

V. PBMS IMPLEMENTATION AT FFRRO

The Federal Facilities Restoration and Reuse Office (FFRRO) works with the Regions, DOD, and DOE on Federal facility issues. FFRRO's mission is to facilitate faster, more effective, and less costly cleanup and reuseof Federal facilities. FFRRO issued guidance and policy and coordinates information exchange regarding Federal facilities among HQ and all the Regions.

A. FFRRO PBMS Victories

The following paragraphs provide a listing and description of past or ongoing FFRRO PBMS victories.

1. Best Practices Information

In response to the OIG audit on Laboratory Data Quality Oversight at Federal Facility Superfund Sites, FFRRO has solicited from the EPA Regions, DOD, and DOE best practice information concerning data quality activities. The Regions have submitted their best practice information. The information from DOD and DOE was due in August, 1997. FFRRO expects that some of the best practices will reflect the flexibility basic to PBMS.

This best practice information will be compiled into a report to be distributed to EPA, DOD, and DOE. This will help expand and disseminate knowledge of the successful approaches under real world conditions.

2. Environmental Restoration Training Course (working with DOE)

EPA and DOE jointly sponsored the Environmental Training course which was taught at several DOE sites. The course emphasized the DQO process, the observational approach, and project-specific method performance needs rather than specific technologies to avoid costly measurement overkill.

3. FFRRO QMP

The QMP is in draft form and is under review at QAD. The final QMP will promote the use of PBMS, where applicable.

B. What Needs to be Done by FFRRO -- Generically

In general, FFRRO needs to facilitate PBMS implementation by:

1. Assuring that PBMS principles are considered and promoted when working with DOD and DOE, especially with respect to responses to IG audit on Laboratory Data Quality Oversight.

2. Implementing the new QMP.

The FFRRO staff will have to be educated as to the provisions of the QMP when it is finalized and accepted by ORD. As part of that education process, the concepts and applications of PBMS will be promoted to the staff.

C. <u>What Needs to be Done by FFRRO -- Specifically</u>

The following page describes a project FFRRO has implemented to promote and establish PBMS on an office-wide basis.

OFFICE: Federal Facility Restoration and Reuse Office (FFRRO)

TITLE OF SPECIFIC PROJECT OR REGULATION: Incorporate PBMS Principles into the Implementation of Response to IG Audit on Laboratory Data Quality at Federal Facilities.

DESCRIPTION:

FFRRO works with the Regions, DOD, and DOE on Federal facility issues. FFRRO's mission is to facilitate faster, more effective, and less costly cleanup and reuse of Federal facilities. Toward this end, FFRRO issues guidance and policy. FFRRO coordinates information exchange among HQ and all the Regions.

In June 1997, EPA HQ responded to the IG audit report titled Laboratory Data Quality at Federal Facility Superfund Sites. OSWER responded to 12 recommendations. At this point, FFRRO has the lead on implementing the response to the audit. The response includes working with other EPA offices, DOD, and DOE on establishing minimum quality assurance systems the Federal facilities should have in place when generating environmental data.

TIMELINE AND OUTPUTS:

<u>Overall Project Start and Completion Dates</u>: 10/98 - 12/99

Relevant Milestones		
Milestone	**Description of PBMS-related Output/Accomplishment**	**Est. Completion or Achievement Date**
Compile Best Practice information from Regions, DOD, and DOE	List of Best Practices concerning Federal facility data quality - some of which emphasize PBMS	October 1998
Framework for QA requirements	Coordinate with EPA HQ, Regions, DOD, and DOE on developing QA procedures	April - December 1999

VI. PBMS IMPLEMENTATION AT CEPPO

A. CEPPO PBMS VICTORIES

The following paragraphs provide a listing and description of past or ongoing CEPPO PBMS victories.

1. Integrated Contingency Plan ("One Plan") Guidance

The National Response Team (NRT) has developed this"one plan" guidance as a result of recommendations in the December 1993 NRT Report to Congress:*A Review of Federal Authorities of Hazardous Materials Accident Safety.* The five agencies that signed theone plan guidance include EPA, the Coast Guard, OSHA, the Office of Pipeline Safety of DOT, and Minerals Management Services in the Department of the Interior. "One Plan" guidance provides a mechanism for consolidating multiple facility response plans required by various regulations into one functional emergency response plan or integrated contingency plan (ICP). The one-plan approach will minimize duplication of effort and unnecessary paperwork burden for the regulated community. The one plan guidance was published in the Federal Registeron June 5, 1996 (61 FR 28643).

2. Risk Management Program Regulations

Section 112(r) of the Clean Air Act Amendments of 1990 requires EPA to publish rules and guidance for chemical accident prevention. These rulesmust include requirements for sources to develop and implement risk management programs that incorporate three elements: a hazard assessment, a prevention program and an emergency response program. These programs are to be summarized in a risk management plan (RMP) that will be made available to State and local government agencies and the public. CEPPO chose to have a performance-based regulation set the measure of the risk management program. The Risk Management Program regulations were published in the Federal Register on June 20, 1996 (61 FR 31668).

3. General Duty Clause

Section 112(r)(1) of the amended Clean Air Act outlines the general duty for the owner and operator of a stationary source "in the same manner and to the same extent as" the general duty provision under the Occupational Safety and Health Act to identify hazards which may result from accidental releases using appropriate hazard assessmenttechniques, to design and maintain a safe facility, and to minimize the consequences of accidental releases which do occur. The clause applies to any facility, of any size, that handles any extremely hazardous substance, regardless of the quantity on site. EPA has chosen not to write regulations for this clause, to instead use industry standards as the performance measure for this clause.

B. What Needs to be Done by CEPPO -- Generically

CEPPO needs to implement the measurements (ICP, RMP etc.) in a manner that ensures quality performance. Also, CEPPO needs to reply to the regulated community's requests for more specific guidance on how to comply with the measurement. CEPPO also needs to do an up-front identification of which programs/analyses lend themselves toPBMS, and which ones do not, as has been done in some media programs.

C. <u>What Needs to be Done by CEPPO -- Specifically</u>

CEPPO has implemented or plans to implement the following specific projects to promote and establish PBMS on an office-wide basis:

Section 112(r)(7)(B) of the Clean Air Amendments of 1990 requires EPA to develop guidance documents, including model risk management plans, to assist stationary sources in the development of risk management programs. To date, three guidance documents have been published: "RMP Offsite Consequence Analysis Guidance"; "Model Risk Management Program and Plan for Ammonia Refrigeration" and "Risk Management Plan Data Elements". CEPPO will revise and update these guidance from time to time as stakeholders and will proceed in implementing the Risk Management Program regulations.

The Relationship Between SW-846, PBMS and Innovative Analytical Technologies

Prepared by EPA's Technology Innovation Office

It has become a widespread misconception that EPA "approves" (in a restrictive sense) which methods may be used to generate data within the RCRA or Superfund programs, and that these methods must be used as written in SW-846. The reasoning then becomes that new technologies or analytical methods cannot be used unless they appear in SW-846. **This is a myth!**

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (known as SW-846) is a guidance and reference document meant to *assist* analytical chemists and other users in the RCRA and Superfund programs by suggesting procedures which other analysts have found to be successful for "typical" samples.

Unfortunately, the performance of these methods can be compromised by site-specific matrix interferences. Thus, for some "atypical" samples, if the method is performed as written the results may be inaccurate. In that case, the method MUST be modified or another method selected, to compensate for the interference in order to produce reliable results. The expectation that modifications will sometimes be needed is voiced in the Preface, Disclaimer and Chapter Two of the 3rd Edition of SW-846.

There are only a very few test methods which are required by federal regulation to be performed as written in SW-846. These are called "**method-defined parameters**" because the way the method is performed determines the results. A prime example is the Toxicity Characteristic Leaching Procedure or TCLP--if the test is performed at a different pH or for a different time period than specified, results cannot be expected to provide useful information.

There are only a few method-defined parameter methods in SW-846, the vast majority of SW-846 methods (and much of the testing done during hazardous waste site characterization) are "**parameter-defined methods**." That means the analytical method is measuring an independent quantity, such as the amount of arsenic in a kilogram of soil. The amount of arsenic is an independent, verifiable quantity (although accurately measuring it may be a challenge).

Blanket regulation of parameter-defined methods is not wise for several reasons:

1. Eliminating flexibility forces some testing to be done inappropriately because site-specific issues (such as matrix complexities, recovery issues, or interferences) cannot be addressed.
2. For some site decisions, high quality quantitative data may not needed, only a semi-quantitative or "go or no-go" result is required. It is wasteful to pay for data quality that is not relevant to the site decision, yet that kind of wasteful expense can be incurred when SW-846 methods are requested simply out of habit, rather than as a consequence of careful consideration of the actual data quality needs (also called data quality objectives or DQOs).
3. Finally, analytical rigidity inhibits the development of new and better analytical methods because of the great time lag between introduction of an innovative, improved technologies and regulatory acceptance. While analytical science is making great strides outside the environmental remediation field, application of improved, cost-effective analytical technologies in hazardous site characterization activities is lagging

behind.

It should be noted that there may be instances where prescriptive requirements for the analytical methods to be used for certain projects may be justified. But this should be determined on a case by case, site-specific basis, and not determined by non-specific, blanket regulation.

EPA has repeatedly stated that SW-846 methods are meant to be flexible, and that testing of hazardous waste constituents (which are regulated by 40 CFR 260 through 270) **by methods other than SW-846 methods** is permitted. In addition to the discussions within SW-846 mentioned above, an August 31, 1993 *Federal Register* Notice explicitly stated that "Any reliable method may be used..." This means that **any** analytical method may be used to generate data (whether or not it is currently published in SW-846) as long as it can be demonstrated to

- measure the constituent of concern,
- at the level of concern,
- at the degree of accuracy as identified as necessary to address the site-decision.

To combat the counter-productive trend of analytical method rigidity, EPA is formally adopting the Performance-Based Measurement System (PBMS) approach, as announced in a October 6, 1997 *Federal Register* Notice.

A discussion of PBMS and its implications can be found in the PBMS section of the OSW Method Team's Home Page. PBMS embodies EPA's efforts to break down barriers to the use of new monitoring techniques and to implement the President's program for reinventing government and reforming regulatory policy. The PBMS initiative places regulatory emphasis on obtaining analytical results that provide adequate input into the regulatory decision, but leave the choice of analytical procedure up to the user. Adequate scientific documentation is required to demonstrate that the testing protocol is truly adequate to meet the goal of regulatory compliance.

After PBMS is implemented, EPA will continue to update SW-846 as a guidance and reference document to assist the environmental remediation community.

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http://www.epa.gov/swertio1/products/regs/846clar.htm

EEG-72

A COMPARISON OF THE RISKS FROM THE HAZARDOUS WASTE AND RADIOACTIVE WASTE PORTIONS OF THE WIPP INVENTORY

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Environmental Evaluation Group
New Mexico

July 1999

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FOREWORD

The purpose of the New Mexico Environmental Evaluation Group (EEG) is to conduct an independent technical evaluation of the Waste Isolation Pilot Plant (WIPP) Project to ensure the protection of the public health and safety and the environment. The WIPP Project, located in southeastern New Mexico, is being constructed as a repository for the disposal of transuranic (TRU) radioactive wastes generated by the national defense programs. The EEG was established in 1978 with funds provided by the U.S. Department of Energy (DOE) to the State of New Mexico. Public Law 100-456, the National Defense Authorization Act, Fiscal Year 1989, Section 1433, assigned EEG to the New Mexico Institute of Mining and Technology and continued the original contract DE-AC04-79AL10752 through DOE contract DE-AC04-89AL58309. The National Defense Authorization Act for Fiscal Year 1994, Public Law 103-160, continues the authorization.

EEG performs independent technical analyses of the suitability of the proposed site; the design of the repository, its planned operation, and long-term integrity; suitability and safety of the transportation systems; suitability of the Waste Acceptance Criteria and the compliance of the generator sites with them; and related subjects. These analyses include assessments of reports issued by the DOE and its contractors, other federal agencies, and organizations, as they relate to the potential health, safety, and environmental impacts from WIPP. Another important function of EEG is the independent environmental monitoring of background radioactivity in air, water, and soil, both on-site and off-site.

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The carcinogenic and non-carcinogenic risks from the radioactive and hazardous waste constituents of the transuranic waste to be emplaced at the Waste Isolation Pilot Plant (WIPP) have been estimated. Risks from routine operations, accidents during the operational period, and long-term releases following human intrusion were evaluated separately. The risk from the hazardous waste component was compared numerically to that of the radioactive component.

Six major conclusions resulted from this study:

1. Risks are low in all cases. Lifetime carcinogenic risks are expected to be about 1×10^{-3} for workers and about 1×10^{-8} for members of the public.

2. The expected radiological carcinogenic risks to workers from routine operations and from operational accidents were at least four orders of magnitude greater than the carcinogenic risk from the hazardous waste constituents. Under maximum conditions, the radiological risks are more than two orders of magnitude greater than the hazardous waste risks.

3. During routine operations, a member of the public residing at the WIPP Site Boundary would receive a very low carcinogenic risk (less than 10^{-8} lifetime) from Volatile Organic Compounds (VOCs) and no radiological risk. The radiological risk to a member of the public from average operational accidents is over five orders of magnitude greater than the hazardous waste risk.

4. Radionuclide annual risks to a resident farmer from average releases to the surface following human intrusion 1000 years after WIPP closure are one order of magnitude greater than total risks from VOCs. These long-term risks are two orders of magnitude lower than risks during the operational period and are less likely to occur.

5. Non-carcinogenic risks from VOCs during operation are less than 2% of the Hazard Index and are not important relative to the carcinogenic risks.

6. The evaluations confirmed the intuitive assumption that radiological risk from WIPP wastes are much greater than the risks from hazardous wastes.

1. INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) Project is located in Southeastern New Mexico (See Figure 1-1). WIPP has been constructed by the U.S. Department of Energy (DOE) to provide permanent disposal of long-lived transuranic (TRU) waste from the U.S. defense activities and programs. The facility must comply with 40 CFR 191, Subpart A during the period when radioactive waste are being emplaced (operating period) and with 40 CFR 191, Subpart B and 40 CFR 194 for long-term disposal. The U.S. Environmental Protection Agency (EPA) has concluded that WIPP meets the requirements of 40 CFR 191 and 194 and made a Certification Decision in May 1998 (EPA 1998). The repository begin receiving radioactive TRU wastes in March 1999.

The DOE estimates that 60% of the TRU wastes are "mixed wastes" that is, they contain hazardous wastes (HW) that are regulated under the Resource Conservation and Recovery Act (RCRA). Regulation of WIPP under RCRA has been delegated by EPA to the New Mexico Environment Department (NMED). The NMED will regulate WIPP under the State of New Mexico Hazardous Waste Management Regulations [20 NMAC 4.1]. Draft permits were issued in May and November 1998, but due to the requirements for comments and public hearings, a final permit is not expected before September 1999. Mixed TRU waste cannot be brought to WIPP until a final Hazardous Waste Permit has been issued unless interim status is invoked by DOE.

The delay in opening WIPP for TRU mixed wastes has raised the issue of whether there are any health and safety needs for RCRA regulation of a facility that is regulated for radioactive waste. Two general claims have been made: (1) the HW toxicity is so much less than the radioactive material toxicity that it could be ignored; and (2) adequate control of the radioactive material should automatically provide similar control for the HW.

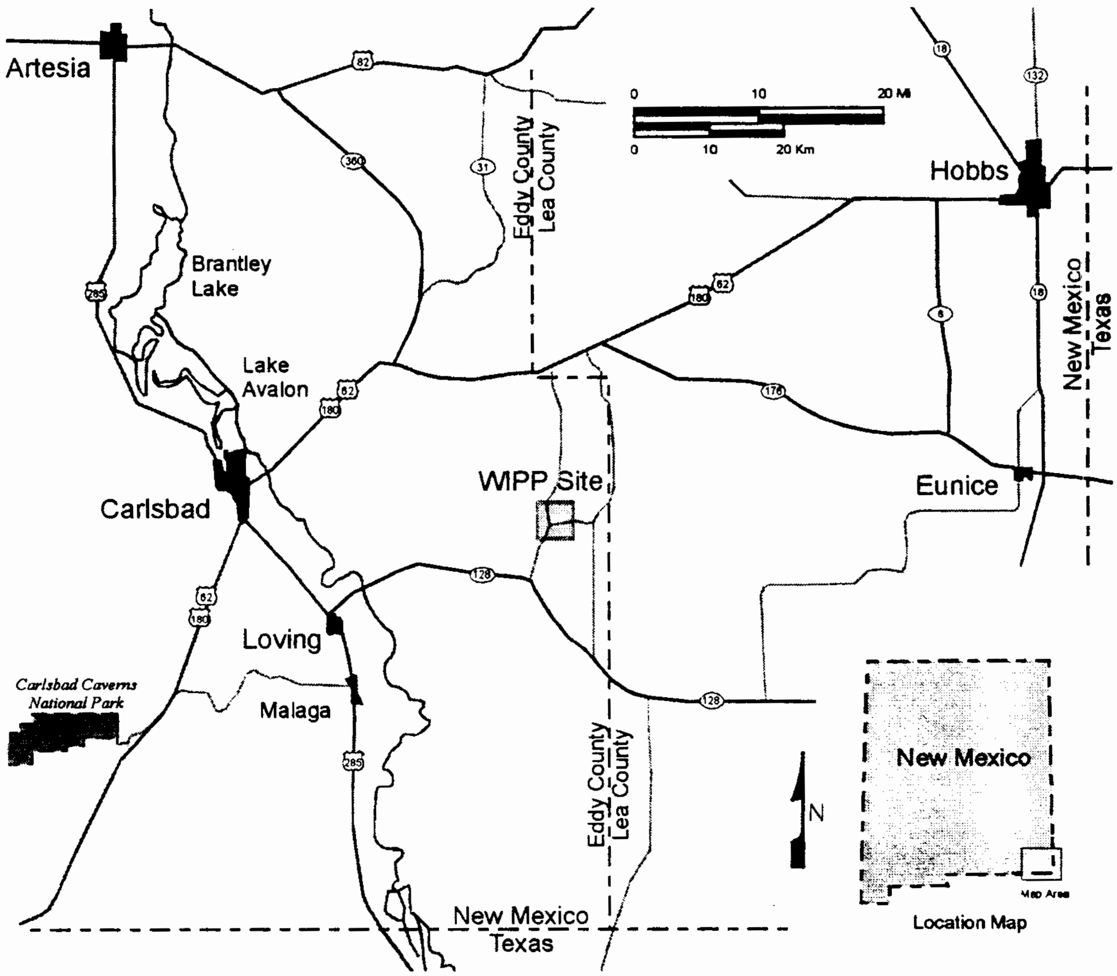


Figure 1-1. WIPP Site Location in Southeastern New Mexico

However, with the exception of a simple comparison of the average TRU waste toxicity to the average Volatile Organic Compound (VOC) toxicity by the National Academy of Sciences (NAS) WIPP Committee, no analyses have been published that evaluated these claims (NAS 1996).

This report evaluated the first claim about relative toxicity by quantitatively comparing the radiological and non-radiological risks to workers and the public from exposures during routine operation of the WIPP facility over the 35 y period of waste emplacement. Risks from accidents during the emplacement period and from long-term releases after repository closure are also evaluated. Carcinogenic risks are expressed in probabilities of an excess cancer fatality (ECF). Non-carcinogenic risks are compared to a Hazard Index (HI). Calculations of exposure scenarios are deterministic rather than probabilistic. The analyses are limited to Contact-Handled TRU (CH-TRU) wastes because there are no hazardous waste data on Remote-Handled TRU (RH-TRU) waste and releases from operational and long-term accidents have had very little evaluation. The exclusion of RH-TRU waste is not expected to significantly affect the comparison because it contains only 4% of the waste volume, less than 14% of the total radioactivity (at the time of emplacement), and less than 1% of the long-lived radioactivity.

2. INVENTORY

The origins of the inventories used for VOCs, hazardous metals, and TRU radionuclides are described separately below.

2.1 Volatile Organic Compounds

DOE reports headspace gas analyses for 28 VOC constituents from 930 drums of CH-TRU waste in Appendix C2 of their RCRA Part B Permit Application (the Application, DOE 1997a). Drums from all 12 Waste Matrix Code Groups (WMCGs) were sampled. Average values for each VOC constituent for each WMCG were calculated. In most cases average concentrations were heavily influenced by a few high values and were much higher than median values. The relative volume of each WMCG (Table 3-5, Baseline Inventory Report, Revision 1, DOE 1995) was used as a weighing factor, and the weighted average concentration for each VOC constituent was calculated by:

$$\bar{x} = \sum_{j=1}^{j=t} w_j \, x_j, \tag{1}$$

where

$\bar{x}$ = weighted average concentration (ppmv)

x_j = average for $WMCG_j$

w_j = weighing factor for $WMCG_j$

t = number of WMCGs

The calculations for average values of several VOCs in each WMCG, the WMCG weighing factors, and the weighted average values of the key VOCs were checked. Our calculated values agreed with the values reported by the DOE.

DOE (Appendix D13 of the Application) performed a VOC screening to determine the most significant carcinogenic and non-carcinogenic VOCs that needed to be regulated. The weighted average head space gas concentration was multiplied by the unit risk factor (URF) for each carcinogenic VOC and by the chronic reference dose for exposure (R*f*C) to non-carcinogenic VOCs to obtain a calculated score. The VOCs that included 99% of the total calculated score in each category were retained for regulation.

The Environmental Evaluation Group (EEG) agreed with the calculation for carcinogenic VOCs. However, EPA's Integrated Risk Information System (IRIS) database (EPA 1999) does not consider 1,1,1-Trichloroethane to be a carcinogen, so it was not included in our calculations. The six retained VOCs (in order of decreasing risk) were carbon tetrachloride (76%), 1,1,2,2-Tetrachloroethane (8%), Chloroform, 1,1-Dichloroethylene, 1, 2-Dichloroethane, and Methylene Chloride. Values of the headspace gas concentrations for the carcinogenic VOCs are given in Table 3-1.

DOE reported that two non-carcinogens (Chlorobenzene and Toluene) comprised over 99% of the calculated risk. An error was found in DOE's Methyl Ethyl Ketone calculated score, and it should have been included. Also, 1,1,1-Trichloloroethane needs to be added. The corrected percent of total risk values are 50% for Chlorobenzene, 43% for 1,1,1-Trichloroethane, 3% for Methyl Ethyl Ketone, and 3% for Toluene.

2.2 Hazardous Metals

DOE presented no information on hazardous metal concentrations or quantities in either the Application or the Final No-Migration Variance Petition. They justified this lack of data by stating: "The DOE presents several implicit assumptions related to demonstrating no-migration for liquid-phase hazardous constituents, but believes that explicitly defining a source term for liquid-phase hazardous constituents is inappropriate, given the available information" (page 8-36 of DOE 1996a). DOE's position basically is that only VOC releases are credible under

assumptions required by RCRA regulation. The NMED has not objected to this determination nor asked for hazardous metal data.

To compare the total risks from HW, it is necessary to consider the risks from hazardous metals due to accidental releases during operation and for long-term releases including human intrusion, even if the risks are not required by RCRA regulations. The possible migration of hazardous metals would be similar to evaluations of TRU radionuclide migration required under 40 CFR Part 191 (EPA 1993).

Some data are available on a few of the RCRA-regulated hazardous metals. These data are reported in the WIPP Disposal Phase Final Supplemental Environmental Impact Statement (SEIS-II, DOE 1997b) and in the WIPP Safety Analysis Report (SAR, DOE 1999). The average concentrations of beryllium, cadmium, lead, and mercury are shown in Chapter 4.

2.3 Radionuclides

Three different aspects of the radionuclide inventory are important when comparing radionuclide risks with those of VOCs or hazardous metals. These are: (1) the concentration of TRU radioactivity at time of emplacement; (2) the concentration of TRU radioactivity at the time of repository closure; and (3) the external radiation received from waste containers.

The radionuclide inventory at time of emplacement is taken from Draft Appendix WCA (Table WCA-5) of the Compliance Certification Application (CCA, DOE 1996b). The inventory at time of closure is taken from Table 4-8 of the CCA. Values for the significant radionuclides are given in Chapter 4.

The external radiation dose received by workers at WIPP from routine surface and underground operations is assumed to be 18.2 person-rem/y at the full emplacement rate of 6500 m^3/y (DOE 1999). The external dose rates from a stack of emplaced drums in the underground were assumed to be 15.6 mrem/h at 2 to 6 feet and 7.2 mrem/h at 6 to 10 feet distance (DOE 1988).

3. RISKS FROM ROUTINE OPERATIONS

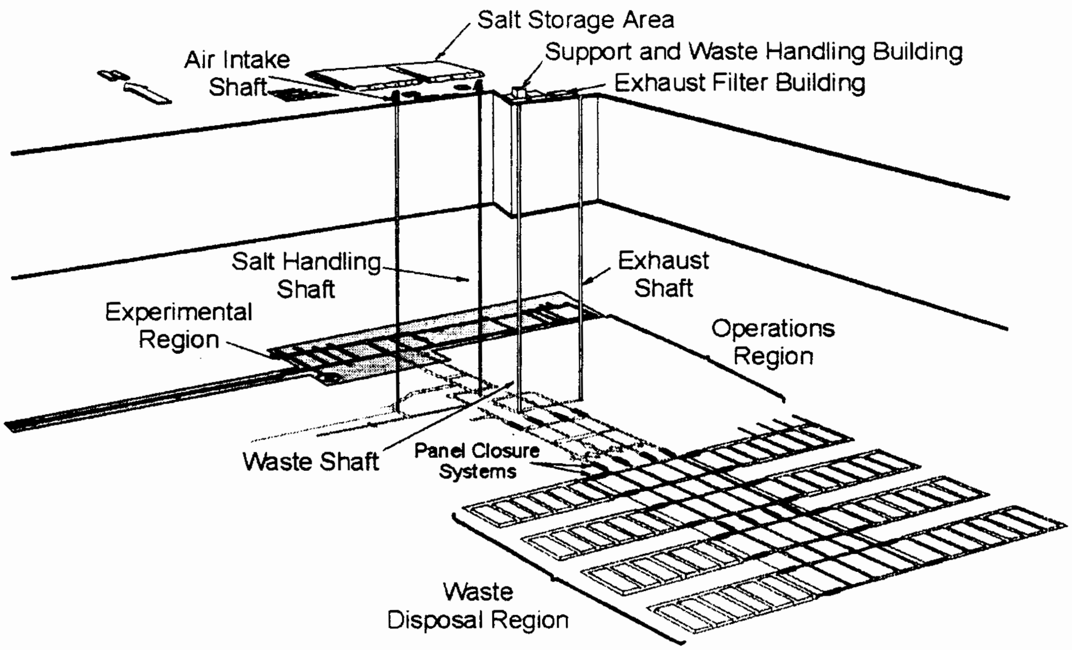
Exposures from HWs and radioactive TRU waste could occur from: (1) routine operations during the 35 y emplacement period; (2) accidents that occur during this operational period; and (3) human intrusion events that occur after the repository is sealed. This report will evaluate the three categories separately for both the hazardous and the radioactive constituents. Values are those used by DOE and/or the State of New Mexico unless stated otherwise. Uncertainties exist in these risk calculations from four sets of estimates and assumptions: (1) inventories of HW and TRU waste in the waste containers; (2) assumptions about the release mechanisms from containers; (3) the location and duration of individual exposure; and (4) the risk coefficients used for both radiation and chemical effects. No attempt will be made to quantify these uncertainties.

A three-dimensional view of the WIPP is shown in Figure 3-1 with a general description of waste panels and rooms. Waste containers are unloaded from TRUPACT-II packages inside the Waste Handling Building (WHB) where exhaust ventilation air passes through high energy particulate aerosol (HEPA) filters. The waste is transported down the waste shaft which originates from within the WHB. Emplacement in waste rooms is always upstream of the ventilation air flow. Ventilation air exhausts through the exhaust shaft and is unfiltered during normal operation.

3.1 National Academy of Sciences Comparison

The NAS (Box 2.1, NAS 1996) compared the risk from inhalation of all the VOCs in 1 m^3 of waste with that from inhaling all the radionuclides in 1 m^3 of waste.

The NAS reported that the inhalation of VOCs in 1 m^3 of waste would lead to a risk of 9×10^{-5} excess cancer fatalities (ECFs). The average TRU waste concentration of 20 Ci/m^3 leads to a radionuclide inhalation risk of about 6.5×10^5 or about 7×10^9 greater than the VOC risk.



Note: For illustrative purposes only.
Not to scale.

Figure 3-1. The WIPP facility includes surface support buildings, a waste handling building, four shafts, and the mined underground operations area. The repository is located approximately 658 m (2150 ft) below the surface, within the Salado Formation, a Permian sequence of bedded salt with minor amounts of anhydrite and clay. The excavations are accessible from the surface by four verticle shafts. Only one of the eight panels has been excavated to date. Each panel consistes of seven rectangular rooms, 10 m wide and 91 m long, separated by 30.5 m wide pillars. Source: DOE 1996b

The NAS calculation is computationally correct but not an appropriate comparison. The VOCs will escape the containers through filtered vents during routine operations and will be inhaled by anyone downstream from the source. Barring an accident, no release of TRU waste or non-volatile HW from waste containers is expected.

The only expected radiation dose at the WIPP Site is from external radiation from waste containers. Persons involved in receiving, checking, transporting, and emplacing waste containers in underground disposal rooms will receive a measurable amount of radiation. The estimated risk from external radiation is compared to VOC emissions in this chapter.

3.2 Routine VOC Exposures and Risks

Routine exposure assumptions for underground workers, surface workers and the public are similar to those used in Appendix D9 of the Application. The values for the exposure concentration in the underground (ECU), the exhaust shaft concentration (ECS), air dispersion factors (ADFs) for the surface worker and the WIPP Site Boundary were determined using Appendix D9 methodology. Assumed underground ventilation air rates (35,000 ft^3/min in a room and 260,000 ft^3/min total) are taken from the November 1998 Draft Permit (NMED 1998).

The risks of cancer (dimensionless) from each VOC can be determined for the underground worker, the surface worker, and the resident at the site boundary from:

$$
\begin{aligned}
\text{Risk} &= \text{ECU (URF) Fu} \\
&= \text{ECS (ADF)s (URF) Fs} \\
&= \text{ECS (ADF)b (URF) Fb}
\end{aligned}
$$

where:	URF	=	the cancer unit risk factor in $m^3/\mu g$ for each VOC
	F	=	the fraction of lifetime inhalation ($8400 m^3/y$ for 70 y) that occurs in the scenario
	u	=	value for underground worker
	s	=	values for surface worker
	b	=	values for boundary resident

The risk factors used were the same as those in Appendices D9 and D13. These values were checked with the IRIS data base to ensure the latest information was used. The considerable uncertainty in most of these risk factors is discussed in IRIS.

3.2.1 Underground Worker

The process of waste emplacement in rooms and panels is shown in Figure 3-2. A worker will normally be downstream from emplaced waste only when drums are being emplaced in the exit drift. This location will be downstream from all filled rooms. The filled rooms will have ventilation barriers; no flow of ventilation air, but some emanation of gases is assumed to occur through the barriers. This emanation from open panels will also be a source of above ground exposure. Panel seals will be emplaced after a panel is completely filled. However, it is assumed gaseous emissions will continue from all filled panels and this will be a source of exposure to persons above ground.

The underground worker is assumed to be present downwind (in the exhaust drift) from a panel of wastes where six of the seven rooms are full and have ventilation barriers. The annual amount of each VOC displaced from a room through a ventilation barrier is:

$$\frac{moles}{y}\ VOC_i = 0.5\ \frac{moles}{drum\text{-}y}\ (11{,}571\ \frac{drums}{room})\ (Molecular\ Fraction\ VOC_i). \qquad \textbf{(2)}$$

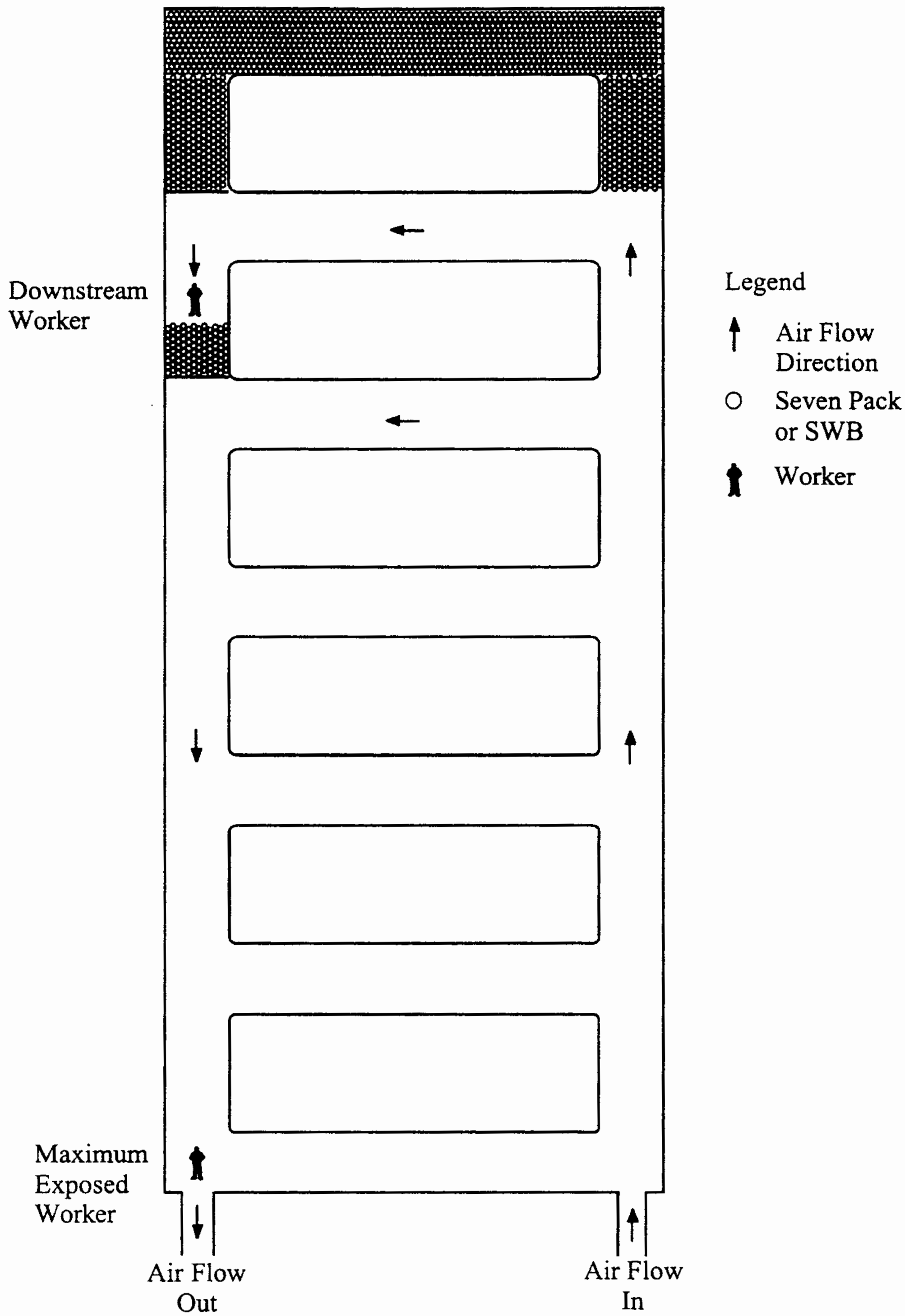


Figure 3-2. Waste Emplacement Process (Source: DOE 1999).

DOE (in Appendix D9) made two assumptions: all VOCs were displaced through the exhaust drift ventilation barrier, and the worker is present in this maximum downwind location 33 h per year for a 10 y period. DOE time-motion studies (DOE 1988) for general emplacement and for emplacement of magnesium oxide sacks (DOE 1999) estimated an exposure time of about 11.5 minutes per 7-pack for the maximum individual. This is equivalent to 148 h/worker for emplacing the 776 7-packs/y in the 133 ft. of waste rooms that is downwind from ventilation barriers. For two-shift operation the maximum individual worker would be exposed 74 h/y. However, since the worker will be exposed to an average of three closed rooms with ventilation barriers, the equivalent six room exposure time is 37 h/y. Thirty-seven hours per year for 10 years is equivalent to 7.55×10^{-4} of a worker's lifetime. The average and maximum risks for those VOCs that are carcinogenic are shown in Table 3-1. All rooms are assumed to be filled with wastes at the maximum allowed room values (Room Based Concentration Limits - RBCLs) for the maximum values and at the weighted average values for the average values. The risk from all carcinogenic VOCs is combined to give a total risk. These risks are the upper 95 percentile estimates for each VOC, and the totals may be artificially high (EPA 1989).

Risks from non-carcinogenic VOCs were also evaluated. Non-carcinogenic effects to members of the public are evaluated using a hazard quotient (HQ), defined as:

$$HQ_i = \frac{average\ exposure\ concentration\ VOC_i}{RfC_i}\ (fraction\ of\ time\ exposed). \qquad \textbf{(3)}$$

For a 10 y exposure period and 37 h/y of exposure at an inhalation rate of 1.2 m^3/h the fraction of a 35 y working lifetime exposure is 1.5×10^{-3}.

Table 3-1
Lifetime Carcinogenic Risks from Routine VOC Emissions to the Underground Worker

VOC	URF[a] ($m^3/\mu g$)	Maximum Values			Weighted Average Values		
		Room Limit[b] (ppmv)	ECU ($\mu g/m^3$)	Risk	Headspace[c] (ppmv)	ECU ($\mu g/m^3$)	Risk
Carbon Tetrachloride	1.5×10^{-5}	11,475	118.0	1.3×10^{-6}	375.	3.85	4.4×10^{-8}
Chloroform	2.3×10^{-5}	9,130	72.7	1.3×10^{-6}	25.3	0.199	3.5×10^{-9}
1,1-Dichloroethylene	5.0×10^{-5}	5,050	32.6	1.2×10^{-6}	11.5	0.0743	2.8×10^{-9}
1,2-Dichloroethane	2.6×10^{-5}	3,350	22.1	4.3×10^{-7}	9.1	0.0601	1.2×10^{-9}
Methylene Chloride	4.7×10^{-7}	100,000	566.	2.0×10^{-7}	368.	2.08	7.4×10^{-10}
1,1,2,2 -Tetrachloroethane	5.8×10^{-5}	2,720	30.4	1.3×10^{-6}	9.4	0.105	4.6×10^{-9}
Totals				5.8×10^{-6}			5.6×10^{-8}

[a] Unit Risk Factor for carcinogens.
[b] VOC room-based concentration limits (RBCLs) (NMED 1998).
[c] Weighted average headspace gas concentration (Appendix C-2 of the Application).

A HI can then be calculated from the sum of HQ_i values for all VOCs (t) with non-carcinogenic effects:

$$HI = \sum_{i=1}^{i=t} HQ_i. \tag{4}$$

RfC_i is the chronic reference dose for exposure by inhalation from VOC_i. For HI values of less than 1.0, adverse health effects are unlikely even to sensitive populations, and values much below 1.0 have no precise meaning. The HI is definitely not probabilistic i.e., a value of 0.01 does not imply a 1% probability of an effect. EPA allows HI values from all compounds having non-carcinogenic effects to be summed to obtain an overall HI. However, the meaning of this total HI value is uncertain because different effects are often being summed. None of the carcinogenic compounds in Table 3-1 had RfC values for non-carcinogenic effects and thus did not have to be included in the HI. HQ and HI values are given in Table 3-2. The HI for the RBCLs is less than 0.01 and thus not a cause for concern.

For occupational workers, it is more appropriate to use Occupational Safety and Health Administration (OSHA) or American Conference of Governmental Industrial Hygienists limits for a time weighted average (TWA) over an 8 hour workday. There is also another short-term limit, the Immediately Dangerous to Life or Health Limit, which is of primary concern in accident scenarios where puff releases could occur. TWA values (in mg/m^3) are also shown in Table 3-2.

The maximum exposure concentrations for individual VOCs are two to four orders of magnitude below the OSHA TWA values, and the summed total value for all VOCs is only 1.0% of allowable. Therefore, there is no concern about the underground worker approaching TWA limits.

Table 3-2
Hazard Quotient and Hazard Index from Non-Carcinogenic VOC Exposures to Underground Workers

VOC	RfC(μg/m³)	Maximum Concentrations		Weighted Average Concentrations		
		Exposure Conc. (μg/m³)	Hazard Quotient	Exposure Conc. (μg/m³)	Hazard Quotient	8 Hour TWA (mg/m³)
Chlorobenzene	20	98	7.4×10^{-3}	0.094	7.1×10^{-6}	350[a]
Toluene	400	68	2.6×10^{-4}	0.12	4.5×10^{-7}	750[a]
Methyl Ethyl Ketone	1000	~31	4.7×10^{-5}	0.31	4.6×10^{-7}	5[b]
1,1,1-Trichloroethane	700	420	9.0×10^{-4}	2.8	6.1×10^{-6}	1900[a]
Totals (Hazard Index)			8.6×10^{-3}		1.4×10^{-5}	

[a] American Conference of Governmental Industrial Hygiene Value.
[b] OSHA value that should not be exceeded at any time.

3.2.2 Surface Worker

The surface worker is assumed to be exposed to VOC emissions from the repository exhaust shaft for 1920 h/y for a period of 10 y. The ADF is taken as 1.23×10^{-2}, and the Fs factor is 3.92×10^{-2}. All of these assumptions are identical to those in Appendix D9 of the Application.

Risks from carcinogens were calculated for a maximum condition and an average condition. The scenario assumed that VOCs would be released through ventilation barriers from eight closed panels and four closed rooms and from 9,000 drums of waste in an open room (the average condition of the repository for the last 10 years of waste emplacement). For the maximum risk, all rooms are assumed to have headspace gas concentrations at the RBCLs from Table IV.D.1 (NMED 1998). Average risk calculations assumed that all rooms were at the weighted average concentration. The calculated risks and exposures are shown in Table 3-3.

Risks to the surface worker for non-carcinogens are slightly greater than those for the underground worker because the occupancy time is 52 times longer. The HI totaled 0.014.

3.2.3 Public Resident at Site Boundary

The Maximum Individual Receptor (MIR) is assumed to be a member of the public continuously residing at the WIPP Site Boundary during the entire 35 y projected period of waste emplacement. The MIR will be exposed to both maximum and average VOC emission rates from four closed panels and six closed rooms with ventilation barriers and a full open room in the fifth panel. The maximum case assumes that all rooms are at the RBCLs and the average case uses the weighted average concentrations of headspace gas. The lifetime risks are shown in Table 3-4.

Table 3-3
Lifetime Carcinogenic Risks to the Surface Worker from Routine VOC Emissions

VOC	Maximum Risk		Average Risk	
	ECS($\mu g/m^3$)	Risk[a]	ECS($\mu g/m^3$)	Risk[a]
Carbon Tetrachloride	316.	2.3×10^{-6}	10.3	7.5×10^{-8}
Chloroform	205.	2.3×10^{-6}	0.57	6.3×10^{-9}
1,1-Dichloroethylene	94.4	2.3×10^{-6}	0.22	5.2×10^{-9}
1,2-Dichloroethane	62.0	7.8×10^{-7}	0.17	2.1×10^{-9}
Methylene Chloride	1680.	3.8×10^{-7}	6.2	1.4×10^{-9}
1,1,2,2-Tetrachloroethane	81.7	2.3×10^{-6}	0.28	7.9×10^{-9}
Totals		1.0×10^{-5}		9.7×10^{-8}

[a] Values rounded from three significant figures.

The source term assumptions for the average case could be non-conservative because the assumptions do not consider a room with RBCL VOC concentrations. However, the chance of having a room containing concentrations close to the maximum for all VOCs is slight; if it occurred, this room would be receiving wastes for only about 6 months in the 35 y exposure period. Another non-conservatism would be if the actual weighted average concentrations in the final inventory turn out to be greater than now estimated. Offsetting the non-conservatism are two other assumptions: a resident will be located continuously at the site boundary location with the highest ADFs and sealed panels will not pressurize and contain some of the VOC emissions. The maximum case should be a plausible upper limit risk.

Table 3-4
Lifetime Carcinogenic Risks to WIPP
Site Boundary Resident from Routine VOC Emissions

VOC	Maximum Risk		Average Risk	
	ECS (μg/m^3)	Risk[a]	ECS(μg/m^3)	Risk[a]
Carbon Tetrachloride	240	2.2×10^{-7}	8.0	7.2×10^{-9}
Chloroform	160	2.2×10^{-7}	0.45	6.2×10^{-10}
1,1-Dichloroethylene	75	2.2×10^{-7}	0.17	5.1×10^{-10}
1,2-Dichloroethane	49	7.6×10^{-8}	0.13	2.1×10^{-10}
Methylene Chloride	1340	3.8×10^{-8}	5.0	1.4×10^{-10}
1,1,2,2-Tetrachoroethane	64	2.2×10^{-7}	0.22	7.6×10^{-10}
Totals		1.0×10^{-6}		9.4×10^{-9}

[a] Values rounded from three significant figures.

3.3 External Radiation

3.3.1 Assumed External Radiation Exposure

The SAR assumes that external radiation doses would be 18.2 person-rem/y for about 20 waste handlers and an unspecified number of radiation technicians but does not attempt to estimate maximum or average individual doses. Since we have calculated VOC intakes and risks to individuals rather than populations, it is appropriate to develop external radiation dose assumptions for both the maximum and the average exposed individual.

Data from waste processing and handling activities at the DOE generating and storage sites suggest that the projections in the SAR for WIPP are too large (DOE 1998). The overall average exposure for all workers where there is measurable exposure is 0.059 rem/y. Also, less than 1% of all exposures are greater than 0.5 rem/y. For the predominately TRU waste activities at the Idaho National Engineering and Environmental Laboratory (INEEL) and Los Alamos National Laboratory (LANL), the averages are 0.048 and 0.040 rem/y. At INEEL, 11.4% of all exposures

were between 0.1 and 0.25 rem/y, and none were >0.25 rem/y. At LANL 8.9% were in the 0.1-0.25 rem/y range, 2.2% in the 0.25-0.50 rem/y range, and none were >0.5 rem/y.

Although the regulatory limit is 5 rem/y, the maximum permitted dose (administrative limit) for a radiation worker at WIPP is 1.0 rem/y. Assuming that DOE will not allow the administrative limit to be exceeded, the maximum plausible exposure for an individual is taken as 1.0 rem/y for a 10 y period.

The average dose to the maximally exposed worker is assumed to be 0.25 rem/y for a 10 y period. This dose is likely to approximate the upper 95% probability level for all exposed waste management workers.

3.3.2 Risks from External Radiation Exposure

The risk coefficient used for low linear energy transfer - low dose rate occupational exposures is 3.9×10^{-4} (ECF)/rem (EPA 1994). This coefficient leads to an ECF risk of 3.9×10^{-3} for the maximum plausible risk and 9.8×10^{-4} for the average dose to the maximally exposed worker.

3.4 Comparison of VOC and External Radiation Risk

The risks from VOC releases and from external radiation exposure are shown in Table 3-5. Ratios of the radiation risk relative to the VOC risk are also given. There are several clarifying remarks about the table: (1) the assumptions for the various scenarios differ and may not contain equal degrees of conservatism; (2) the surface workers exposed to VOCs may not be occupationally exposed to radiation; and (3) the public resident at the site boundary is assumed to be exposed to low concentrations of VOCs from WIPP, but no radiation.

Table 3-5
Comparison of VOC and Radiation Cancer Risks[a]

Exposed Person	Maximum Risk		Average Risk	
	Risk	Ratio Rad/VOC	Risk	Ratio Rad/VOC
Underground Worker, VOC	5.8×10^{-6}	670	5.6×10^{-8}	17,000
Surface Worker, VOC	1.0×10^{-5}	380	9.7×10^{-8}	10,000
Boundary Resident, VOC	1.0×10^{-6}	3900	9.4×10^{-9}	100,000
Radiation Worker	3.9×10^{-3}		9.8×10^{-4}	

[a] Values rounded from three significant figures.

3.4.1 Comparison of Risks to Workers

The results presented in Table 3-5 show that for the maximum postulated exposures radiation worker risks are approximately 400 to 700 times greater than VOC risks, or roughly two to three orders of magnitude. For more likely exposure scenarios, the average radiation risks are about four orders of magnitude greater than those from VOC exposure. The average VOC risk to workers is also less than the acceptable risk to members of the public.

These findings indicate that it is much more important, from a risk perspective, to control radiation exposures to workers than to control VOC exposures.

3.4.2 Risks to Resident at WIPP Site Boundary

Table 3-4 shows that average lifetime carcinogenic risks to the resident at the WIPP Site Boundary are over two orders of magnitude below the 1×10^{-6} target risk level set by NMED. Our calculations of the maximum risk confirm that the RBCLs set by NMED will achieve the target risk level.

4. RISKS FROM ACCIDENTS AND LONG-TERM RELEASES

Containers of TRU waste could be damaged and lose a portion of their contents during handling and emplacement at WIPP. Incidents could include dropped containers, punctures by fork lifts, fires, and roof falls in underground disposal rooms. The quantities of radioactive material released from these types of accidents have been evaluated in Environmental Impact Statements, SARs, and other WIPP reports by DOE and EEG over the years. Thus, there is some consensus about the approximate fraction of radionuclides that might be released from a waste container from an accident. The SAR estimates the frequency of seven different release scenarios to be 10^{-2} to 10^{-4}/y (each). This is equivalent to an estimate of 0.024 to 2.4 release accidents during the 35 y operating lifetime of the repository.

SAR evaluations of hazardous waste releases have been limited to VOCs. Typically it has been assumed that all VOCs in the headspace of a waste drum would be released in the event of a release from a drum. SEIS-II assumed that the fractional releases of hazardous metals was the same as for radionuclides. In the absence of specific data, this assumption is reasonable to use when comparing relative risks. Therefore, this report will assume that the fractional releases of hazardous metals are the same as for radionuclides.

4.1 Hazardous Metals Inventory

The average quantities per drum of the most abundant hazardous metals are taken from Table G-6 of SEIS-II and are shown in Table 4-1. No data have been reported on ranges of hazardous metals in waste containers. These values are considered more uncertain than the values for radionuclides and VOCs.

Table 4-1
Hazardous Metals-Average Quantities and Risks Per Waste Drum

Hazardous Metal	Kg per Drum	URF ($m^3/\mu g$)	μg per ECF	ECF per drum
Lead	1.0	–	–	–
Beryllium	0.025	2.4×10^{-3}	2.44×10^{8}	0.10
Cadmium	4×10^{-4}	1.8×10^{-3}	3.27×10^{8}	0.0012
Mercury	0.43	–	–	–

4.2 Operational Accidents

4.2.1 Relative Risks from Operational Accidents

Since the fractional releases of hazardous metals and TRU radionuclides are assumed to be the same for all operational accidents, the relative risk (i.e., the ratio of the radionuclide carcinogenic risk to the hazardous metals carcinogenic risk) can be calculated simply by determining the inhalation risk from all the contents of an average drum for hazardous metals and radionuclides.

Beryllium and cadmium are the only metals in Table 4-1 that are carcinogenic. The URF values and the ECFs per drum from inhalation are also shown in Table 4-1.

The ECFs per drum from TRU waste are determined from the rem/Ci value calculated in Table 4-2, the average Ci/drum (5.0), and the risk coefficient of 1×10^{-4} ECF/rem (NAS 1988).

The 2.0×10^{5} ECFs per drum of TRU waste is 2.0×10^{6} times the 0.10 ECFs per drum of hazardous metals.

Table 4-2
Rem/Curie Value for WIPP TRU Waste Inventory

Radionuclide	Curies at Closing	Fraction	Rem/Ci[a]	Fraction Rem/Ci
^{238}Pu	2.61×10^{6}	0.641	3.92×10^{8}	2.51×10^{8}
^{239}Pu	7.95×10^{5}	0.195	4.29×10^{8}	0.84×10^{8}
^{240}Pu	2.15×10^{5}	0.053	4.29×10^{8}	0.23×10^{8}
^{241}Am	4.48×10^{8}	0.110	4.44×10^{8}	0.49×10^{8}
Total				4.07×10^{8}

[a] Values from EPA 1988

4.2.2 Absolute Risks from Operational Accidents

In the accident being evaluated, it was assumed that only one drum was breached in the WHB. The drum had an average radionuclide concentration and either the weighted average or RBCL VOC concentrations. This differs from the three WHB accidents in the SAR (crane failure, drum puncture, and drum drop) where four to seven drums were breached, and one drum had a high radionuclide concentration. However, the purpose of this report is to evaluate absolute and relative risks from likely rather than low probability accidents.

In an accident all of the VOCs in the drum headspace volume (an average of 146 ℓ) are assumed to be expelled. The URF, weighted average, and RBCL values from Table 3-1 and the molecular weight can be used to determine the headspace inventory and risk from each VOC. These values are shown in Appendix A (Table A-1). The risk from all the headspace VOCs is 1.2×10^{-5} for weighted average VOC concentrations and 1.3×10^{-3} for RBCLs.

It is necessary to calculate the absolute risks (in ECFs) to the maximally exposed worker from VOCs, radionuclides, and hazardous metals because their fractional releases are different. This absolute risk was calculated for a scenario where the instantaneous release from a drum is assumed to expand in an aerosolized cloud at the rate of ventilation air movement in the WHB.

The worker's intake can be modeled as an expanding hemisphere where the decreasing concentration in the cloud is integrated over the assumed time of exposure. The exact solution to this model is given in Appendix A.

The absolute risks from an operational accident are shown in Table 4-3. Three key assumptions were made: (1) the aerosolized and respirable release fraction of radionuclides and hazardous metals is 2.5×10^{-5}. This is an intermediate value among various scenarios modeled in the SAR; (2) the cloud expands in all directions at a rate of 25 centimeters per second; and (3) the maximally exposed worker is located 3 m from the point of release and is exposed to the cloud from 12 to 30 seconds after release.

The absolute risks and ratios for this scenario are shown in Table 4-3.

Table 4-3
Risks to Workers from Radionuclides and Hazardous Wastes
Released During Operational Accidents

Source	Risk	Rad/HW Risk
Radiation Released	1.5×10^{-4}	-
VOC Released (average)	3.7×10^{-10}	4.0×10^{5}
VOC Released (maximum)	3.8×10^{-8}	4.0×10^{3}
Hazardous Metals Released	7.5×10^{-11}	2.0×10^{6}

4.2.3 Risks to Public from Operational Accidents

Radionuclides and VOCs could escape the WHB if the HEPA filters were inoperative (unlikely) or from the underground if the effluent is not HEPA filtered (more likely). The relative risks would be the same assuming the same dispersion values for both radionuclides and VOCs and neglecting radionuclide deposition (about 10% at 800 m and 20% at 4 Km) before reaching the MIR. Absolute risks are low, about 9.5×10^{-9} at the WIPP Site Boundary for a 5 Ci drum.

4.3 Long-Term Releases to Surface

4.3.1 Relative Risks from Long-Term Releases

The CCA (DOE 1996b) provided the technical bases for EPA's determination that WIPP complied with the long-term performance standards in 40 CFR 191 Subpart B. The DOE concluded that the only significant long-term releases to the accessible environment were due to cuttings, cavings, spallings, and direct brine releases brought to the surface as a result of human intrusion into the repository when drilling for oil and gas. (see Figure 4-1). Direct brine releases accounted for less than 1% of the total radionuclide release at the 0.1 probability level and less than 30% at the 0.001 probability level.

Beryllium and cadmium both are quite insoluble. For example, the beryllium concentration in sea water (6×10^{-7} mg/ℓ) is about 7×10^{-11} M. Cadmium's concentration in seawater (1.1×10^{-4} mg/ℓ) is about 1×10^{-9} M. By comparison, the values used in the Performance Assessment Validation Test (an addendum to the CCA) for plutonium and americium ranged from 1.3×10^{-8} M to 8.8×10^{-6} M. This simple comparison suggests that both beryllium and cadmium are less soluble than plutonium and americium and that a direct brine release would not be enriched. Therefore, it is reasonable to assume that the fraction of radionuclide releases to hazardous metal releases for a human receptor on the surface would be the same as that existing in the waste at the time of intrusion. It is necessary to correct for decay in radionuclides before the human intrusion. If the intrusion is assumed to occur 1000 y after closure, the average concentration drops to 1.31 curies per drum and the radionuclide to hazardous metal risk is 5.2×10^{5}.

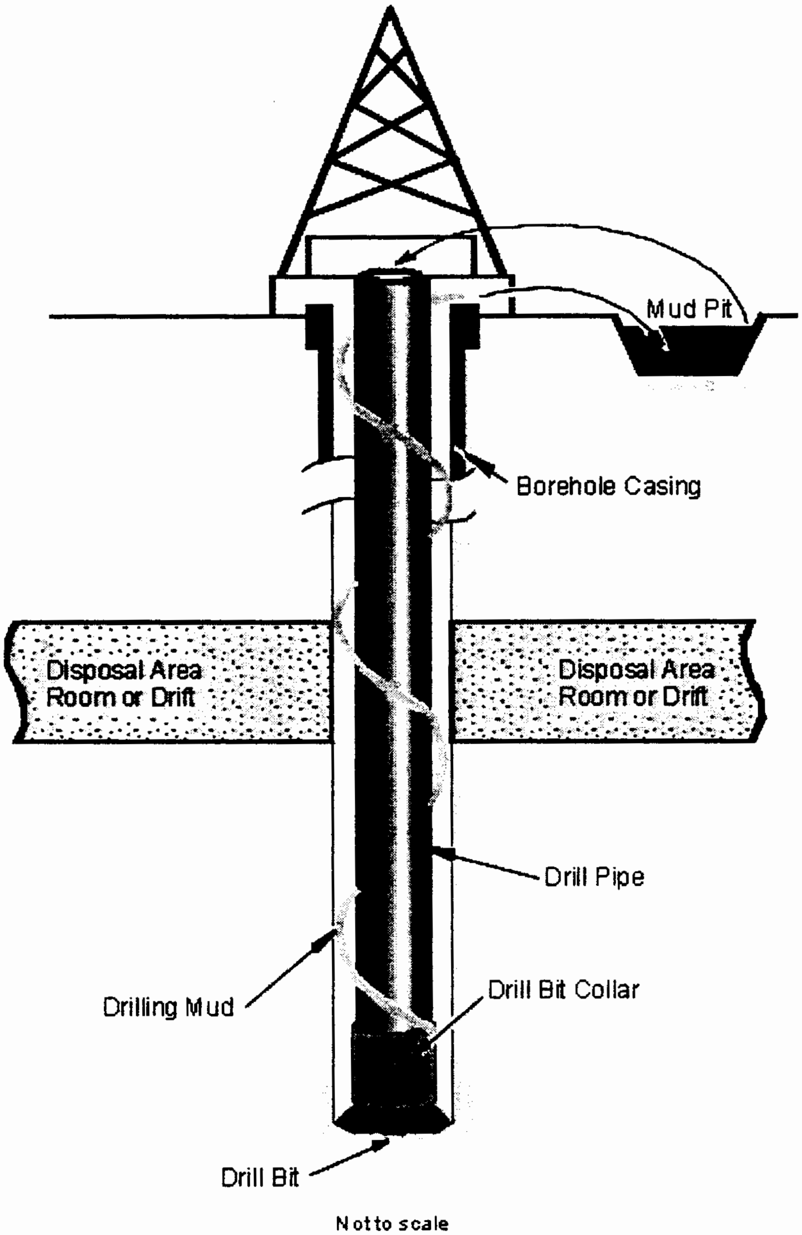


Figure 4-1. Schematic Representation of a Rotary Drilling Operation Penetrating the Repository (Source: DOE 1996b).

4.3.2 Absolute Risks from Long-Term Releases

The modeling assumptions used in the CCA resulted in no gaseous releases to the surface at the time of drilling in 92% of intrusions. The model did assume a significant release of gases from the entire repository 200 y after the intrusion when plugs in the intrusion borehole failed. A large fraction of the gases generated after this initial failure were also assumed to be released. The fraction of gases released from the repository varied significantly among vectors in the probabilistic calculations performed in the CCA. An average value of 85% was assumed in this report (Chapter 8 in Helton 1998).

The carcinogenic risk from releasing 85% of the VOCs in the repository was determined and compared to the risk from the radionuclides brought to the surface. The person receiving the exposure was assumed to be a resident farmer located 800 m from the borehole. Radionuclides and hazardous metals reached this person by resuspension from the drilling mud pit. The same assumptions were used as in EEG-66 (Channell 1998). VOC releases occur 200 y later and are dispersed in the atmosphere as they are vented. The same dispersion values (χ/Q) are used as in EEG-66. Risks to workers at the drilling rig were not used because a drilling rig is not expected to be located at this spot 200 y later.

The relevant assumptions used for VOC risk were: $\chi/Q = 5\times10^{-5}$ sm^{-3}, inhalation of 67 m^3 in 80 h of VOC releases, and total VOC releases equal to 1.02×10^{6} drum headspace volume equivalents (85% of the VOCs in the repository, including equilibrium of room void space with drum headspace gas concentrations). Radionuclide overall release to surface quantity to ECFs value was determined from EEG-66 to be 7.1×10^{-7} ECF/Ci to surface. The mean volume of material brought to the surface was equivalent to 1.66 drums of waste, and the maximum volume was 8.29 drums.

Table 4-4 shows the relative risks of radionuclides and hazardous waste from material brought to the surface by human intrusion. The most likely radionuclide to VOC risk comparison is between

the average quantity and concentration of radionuclides and the average weighted concentration of VOCs. A comparison is also shown between an 8.3 drum, 17 Ci release (about a 5% probability of occurring in 10,000 y) and the room based concentration limits of VOCs.

Table 4-4
Risks of Radionuclides and Hazardous Waste
Brought to the Surface from Human Intrusion at 1,000 Years

Source	Expected Releases		Maximum Releases	
	Risk[a]	Ratio Rad/HW	Risk[a]	Ratio Rad/HW
Radionuclides	1.5×10^{-6}	-	1.2×10^{-5}	-
Hazardous Metals	3.0×10^{-12}	5.2×10^{5}	1.5×10^{-11}	8.1×10^{5}
VOCs	1.5×10^{-7}	1.0×10^{1}	1.5×10^{-5}	8.0×10^{-1}

[a] Radionuclide and hazardous metal risks are for one year exposure. VOC risks are the total value.

Note that the radionuclide to VOC risk is only 10 for expected releases and is 0.80 for maximum releases. This high VOC risk occurs because the model assumes that 85% of the VOCs in the entire repository are released in this one-time occurrence. The radionuclide and hazardous metals release represents only 1.6×10^{-5} of the repository inventory. The ECFs for radionuclides and hazardous metals would continue for many years due to continuing resuspension from the drilling mud pit. So, the lifetime risk to a resident farmer from radionuclide releases would still be greater than the lifetime VOC risk to a (different) resident farmer even in the maximum case.

5. SUMMARY AND CONCLUSIONS

5.1 Summary

Table 5-1 summarizes the average radiological risk and the radiological to hazardous waste relative risks for normal operations, operational accidents, and long-term releases for CH-TRU wastes. Risks from maximum conditions are not summarized because they are considered less likely.

Table 5-1
Average Radiological to Hazardous Waste ECF[a] Risks

Activity	Radiological Risk	Rad/VOC Risk	Rad/H. Metals Risk	Likelihood of Occ.
UG Worker	1×10^{-3}	2×10^{4}	–	~100%
Surface Worker	1×10^{-3}	1×10^{4}	–	~100%
Oper. Accidents	2×10^{-4}	4×10^{5}	2×10^{6}	2%to~100%
Long-Term Rel.	2×10^{-6}	1×10^{1} [b]	5×10^{5}	< 10%[c]

[a] Excess Cancer Fatalities.

[b] VOC risk is total; radionuclide and hazardous metal risks are for one year.

[c] Likelihood of event approaches 100%, but the likelihood of a resident farmer at 800 m is < 10%.

It can be seen from Table 5-1 that the absolute risks to workers are higher for the more likely routine and operational accident activities. The radiological risks from these activities are four to six orders of magnitude greater than the VOC and hazardous metal releases.

The radiological to VOC risk for long-term releases is only one order of magnitude, and the exposed individual is a member of the public. There is also a risk to a member of the public at the WIPP Site Boundary from routine VOC releases, but none from routine radionuclide releases. The absolute risks in both cases are low, 9×10^{-9} lifetime risk at the WIPP Site Boundary and 2×10^{-7} from the long-term VOC release. This is three to five orders of magnitude less than the radiological risk to workers.

5.2 Discussion

5.2.1 Perspective on Risk

An implicit assumption that must be made in comparing these risks is that the exposure to excess cancer death risk coefficients used for the individual VOCs and for radiation exposure are of similar accuracy and uncertainty. However, there is considerable uncertainty in all of these values. All use the linear nonthreshold theory for cancer causation (i.e., that the probability of causing cancer is linearly related to the dose, and no dose is too small to potentially cause cancer), and it is not certain that this theory is valid for any or all of these carcinogens. However, the linear nonthreshold theory and the coefficients used are accepted by the appropriate regulatory agencies and will be accepted here without speculation about their accuracy and uncertainty.

The NMED is applying target risk levels at WIPP to be a maximum lifetime risk to a member of the public (the MIR) of less than 1×10^{-6} and a risk of less than 1×10^{-5} for a nonwaste surface worker. NMED is also requiring that the risks from individual VOCs be summed to determine a total risk. It is unclear whether RCRA requires the summation of risk (DOE contends it does not). The risks were summed in this report to provide an additional conservative measure. The risks to the MIR should be considered in the upper 95% confidence level (i.e., there is only a 5% chance of higher risks).

OSHA and DOE limits control occupational exposures to hazardous material and ionizing radiation rather than individual risks. However, risks are used in this report for comparison because the OSHA and DOE radiation limits are not equally conservative for lifetime carcinogenic risks. For example, the allowed radiation risk to a member of the public (25 mrem/y) during operation of WIPP (from 40 CFR Part 91, Subpart A) would amount to a lifetime risk of 3.4×10^{-4} for the 35 y emplacement period. This is 340 times the 1×10^{-6} lifetime target risk level allowed by NMED. Also, a surface nonradiation worker is permitted to receive a dose of 100 mem/y. For a 10 y exposure period, this would amount to a radiological risk of 3.9×10^{-4} or 39 times the allowed (1×10^{-5}) hazardous waste risk.

5.2.2 Probabilistic Considerations

This report used deterministic rather than probabilistic calculations for two reasons: (1) the primary objective was to obtain average absolute and relative risk values; and (2) no distribution data were available for hazardous metals. RBCL values for VOCs as well as for weighted average values were calculated because we believed these calculations provide an upper limit for possible VOC risk values. The RBCLs were set by NMED to ensure that target risk levels for nonwaste workers and the public were not exceeded and averaged about two orders of magnitude greater than the expected (weighted average values from 930 drums) values.

Routine releases and long-term releases are dominated by average conditions for a room, panel, or the entire repository rather than by the contents of individual waste containers. In operational accidents where releases involved one to seven drums, the risks for a single accident might vary significantly from the averages.

An examination of the data from the 930 drums that had been analyzed for headspace gas found that only six of these drums had headspace VOC concentrations that contained a higher risk per headspace volume than the RBCL values. The highest of these concentrations had a risk of 3.3×10^{-3} (2.57 times the RBCL risk). Use of the risk from this maximum drum would lower the relative radiological/VOC risk from 4.0×10^{3} to 1.5×10^{3}. This is not a significant change.

The radionuclide content of an untreated CH-TRU waste drum will vary from < 1 Ci to 80 Ci, and this will of course change both the absolute risk and relative risk ratio. The range of radiologicial to VOC risks for the operational accident could range from 10^{2} to $> 10^{7}$. Thus, the radiological risk will always be much greater than the VOC risk, even for extreme cases of low radionuclide and high VOC concentrations.

5.3 Conclusions

Risks are low in all cases. Lifetime carcinogenic risks are expected to be about 1×10^{-3} for workers and about 1×10^{-8} for members of the public.

The findings of the evaluations in this report show that for both routine operations and accidents the expected carcinogenic risks to workers from the radiological component of the waste are at least four orders of magnitude greater than the HW component. Even under maximum conditions, the radiological risks are always at least two orders of magnitude greater. There is a low probability that the absolute risks of HW would approach the RCRA target levels allowed under conditions of the NMED Hazardous Waste Permit. However, these risk levels are 40 to 340 times less than the allowed radiation limits.

Hazard Index values from exposure of workers to non-carcinogens are less than 0.02 of allowable for RBCL concentrations and less than 0.01% for expected weighted average concentrations. Doses to radiation workers will be allowed to approach 20% (1 rem/y) of the allowable (5 rem/y), and some doses greater than 5% of the limit (250 mrem) are expected. Therefore, absolute exposures to non-carcinogenic VOCs are not a risk, and the expected exposures are a lower fraction of allowable limits than the expected radiation exposures.

A member of the public residing at the WIPP Site Boundary would receive a very low carcinogenic risk (less than 10^{-8} lifetime) from VOCs and no radiological risk from routine operations. Absolute risks to members of the public from average operational accidents are low, and the radiological risks are over five orders of magnitude greater than the VOC risks.

Risks from hazardous metal releases are one-fifth of the risks from VOC releases in operational accidents and over four orders of magnitude less for long-term releases.

Radionuclide risks from long-term releases to the surface are only an order of magnitude greater than VOC risks for expected conditions and are less than 1.0 in the maximum case. This relative risk comparison is less important than the others for several reasons: (1) the VOC risk is total and the radionuclide risk is only for one year; (2) the occurrence of this scenario is less likely than the others; (3) the model for VOC release, although taken from modeled gas behavior in the CCA, is uncertain, and other models could have been used; (4) the absolute risk is lower than those for the routine and operational accidents activities; and (5) the actual risks would probably be lower than shown in Table 5-1 because a member of the public is likely to be farther away and not in the prevailing wind direction.

These evaluations confirmed the intuitive assumption that radiological risks from WIPP wastes are much greater than the risks from hazardous wastes.

6. ACRONYMS & ABBREVIATIONS

ADF	Air Dispersion Factor
A&R	Aerosolized and Respirable
CCA	Compliance Certification Application
CH-TRU	Contact Handled Transuranic
Ci	Curie
DOE	U.S. Department of Energy
ECF	Excess Cancer Fatality
ECS	Exhaust Shaft Concentration
ECU	Exposure Concentration in the Underground
EEG	New Mexico Environmental Evaluation Group
EPA	U.S. Environmental Protection Agency
ft.	Feet
HEPA	High Energy Particulate Aerosol
HI	Hazard Index
HQ	Hazard Quotient
HW	Hazardous Waste
h	Hour
INEEL	Idaho National Engineering and Environmental Laboratory
IRIS	Integrated Risk Information System (EPA)
Km	Kilometers
LANL	Los Alamos National Laboratory
ℓ	Liter
MIR	Maximum Individual Receptor
m	Meters
μg	Micrograms
mg	Milligrams
min	Minute

ACRONYMS & ABBREVIATIONS

mrem	Millirem
mg/ℓ	Milligrams per liter
M	Molar
NAS	National Academy of Sciences
NMED	New Mexico Environment Department
OSHA	U.S. Occupational Safety and Health Administration
ppmv	Parts per million volume
RBCL	Room Based Concentration Limits
RCRA	U.S. Resource Conservation and Recovery Act
R*f*C	Chronic reference dose for exposure to non carcinogens by inhalation
RH-TRU	Remote Handled Transuranic
SAR	WIPP Safety Analysis Report
SEIS-II	WIPP Disposal Phase Final Supplemental Environmental Impact Statement
TRU	Transuranic
TWA	Time Weighted Average for Exposure Concentrations
URF	Carcinogenic Unit Risk Factor
VOC	Volatile Organic Compound
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant
WMCG	Waste Matrix Code Group
y	Year

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APPENDIX A

APPENDIX A
Calculation of Amount of Material Inhaled in an Operational Accident Involving a Radioactive Release

A common method of assessing the consequences to workers of a release accident involving CH-TRU drums is to assume that the aerosolized and respirable (A&R) material is released instantaneously and expands from a point source as a hemispherical cloud moving at the velocity of the ventilation flow rate. The maximum exposed worker is assumed to be at a given distance for a period of time before exiting the cloud.

The intake (and consequently the dose and the risk) can be solved exactly for this scenario as follows:

$$Intake = (A\&R\ Concentration)\ (Duration\ of\ Exposure)\ (Inhalation\ Rate) \qquad \textbf{(A-1)}$$

The A&R concentration varies with distance since the volume of the hemisphere is constantly increasing.

The A&R concentration is:

$$C_{A\&R} = \frac{Amount\ Released = Q}{\frac{2}{3}\pi r^3}. \qquad \textbf{(A-2)}$$

The radius, r, of the hemisphere can be expressed as a function of time. If the assumed velocity is 25 centimeters per second, the expression becomes:

$$C_{A\&R} = \frac{Q}{\frac{2}{3}\pi(25\,t)^3} = \frac{3.05x10^{-5}\ Q}{t^3}. \qquad \textbf{(A-3)}$$

This function can be integrated with respect to time and when the inhalation rate ($333 cm^3/s$) is included can give the cumulative intake with an assumed time interval.

$$Intake = .0102 \ Q\int_{t_1}^{t^2} t^{-3}dt = -5.10x10^{-3}Qt^{-2}]_{t_1}^{t^2} \quad \textbf{(A-4)}$$

$$I = 5.10x10^{-3} \ Q\left[\frac{1}{t_1^2} - \frac{1}{t_2^2}\right]. \quad \textbf{(A-5)}$$

This expression can be expanded to calculate the risk (excess cancer fatalities - ECF) by:

$$Risk = I\left(4.07x10^8 \ \frac{rem}{Ci} \ inhaled\right)\left(1x10^{-4} \ \frac{ECF}{rem}\right)\left[\frac{Ci}{drum} \ (fraction \ released)\right]. \quad \textbf{(A-6)}$$

For a fraction released of 2.5×10^{-5}, the maximally exposed individual located at 3 m and an exposure time between 12 seconds (t_1) and 30 seconds (t_2), the risk becomes:

$$Risk = 5.19x10^{-3}\left(\frac{Ci}{drum}\right)\left[\frac{1}{12^2} - \frac{1}{30^2}\right] = 3.02x10^{-5}\left(\frac{Ci}{drum}\right). \quad \textbf{(A-7)}$$

For an average drum containing 5.0 Ci, the risk is 1.51×10^{-4} ECF. The risk from hazardous metals is 5.05×10^{-7} of that from radionuclides or 7.63×10^{-11}.

VOC Risk

All VOCs in the drum headspace are assumed to be released in the accident. Table A-1 shows the risk if all the VOCs in the headspace were inhaled by the maximum exposed worker. The above expression can be adapted to determine the fraction of the total VOCs inhaled.

From Equation 5:

$$Intake = 5.10x10^{-3}\ Q\left[5.83x10^{-3}\right] = 2.97x10^{-5}\ Q \qquad \textbf{(A-8)}$$

Q can be taken as 1.0 drums and the risk per drum from Table A-1. Therefore, the risks for the weighted average concentration drum would be 3.71×10^{-10} ECF and for the RBCL drum would be 3.81×10^{-8} ECF.

Table A-1
Risks from VOCs in Drum Headspace Volume

VOC	mg per lifetime[a] for unit risk	Weighted Average Concentration		RBC Limits[b]	
		mg/drum	ECF per drum risk	mg/drum	ECF per drum risk
Methylene Chloride	1.25×10^{9}	205.2	1.64×10^{-7}	5.5×10^{4}	4.46×10^{-5}
Chloroform	2.56×10^{7}	19.8	7.73×10^{-7}	7.15×10^{3}	2.79×10^{-4}
1,1,2,2-Tetrachloroethane	1.01×10^{7}	10.4	1.03×10^{-6}	3.00×10^{3}	2.97×10^{-4}
Carbon Tetrachloride	3.92×10^{7}	378.9	9.67×10^{-6}	1.16×10^{4}	2.95×10^{-4}
1, 1 Dichloroethylene	1.18×10^{7}	7.31	6.22×10^{-7}	3.21×10^{3}	2.72×10^{-4}
1, 2 Dichloroethane	2.26×10^{7}	5.91	2.26×10^{-7}	2.17×10^{3}	9.62×10^{-5}
Total			1.2×10^{-5}		1.3×10^{-3}

[a] $\frac{mg}{lifetime} = \frac{5.88x10^{5}m^{3}/lifetime}{URF \quad m^{3}/\mu g}(10^{-3}mg/\mu g)$

[b] *RBCL Room Based Concentration Limit*

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